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FOR THE

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BRIDGING NAVIGABLE WATERS OF THE UNITED STATES.

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(1) REPORT of Maj. J. D. Miley, U. S. Volunteers, first lieutenant, Second Artillery, on operations in the Department of California, 3783; (2) report of Lieut. John B. Bennet, Seventh Infantry, on operations in the Department of the Columbia, 3784.

LAWS AFFECTING THE CORPS OF ENGINEERS, FIFTY-FIFTH CONGRESS, SECOND SESSION, 1897-98 3789

ANNUAL REPORT

OF THE

CHIEF OF ENGINEERS,

UNITED STATES ARMY.

1898.

REPORT

OF

THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., September 29, 1898.

SIR: I have the honor to present for your information the following report upon the duties and operations of the Engineer Department for the fiscal year ending June 30, 1898:

OFFICERS OF THE CORPS OF ENGINEERS.

The number of officers holding commissions in the Corps of Engineers, U. S. Army, at the end of the fiscal year was 123.

Since the last annual report, the Corps of Engineers has lost two of its officers by death: Lieut. Col. William R. King, who died on May 18, 1898, and Maj. James F. Gregory, who died on July 31, 1897.

There were added to the Corps of Engineers, by promotion of graduates of the Military Academy, fourteen additional second lieutenants, seven on July 13, 1897, to date from June 11, 1897, and seven on May 13, 1898, to date from April 26, 1898.

On the 30th of June, 1898, the officers were distributed as follows:

Commanding the Corps of Engineers and Engineer Department	1
Office of the Chief of Engineers and Light-House Board	1
Office of the Chief of Engineers	1
Board of Engineers, Board of Visitors to United States Engineer School	1
Division Engineer	1
Fortifications, Division Engineer, and California Débris Commission	1
River and harbor works and light-house districts	2
Fortifications and river and harbor works	43
Mississippi River Commission, Missouri River Commission, and light-house district	1
Fortifications, river and harbor works, California Débris Commission, and light-house district	1
Fortifications, river and harbor works, and light-house districts	1
Mississippi River Commission, Missouri River Commission, and river and harbor works	1
Board of Engineers, fortifications, and river and harbor works	1
Fortifications, river and harbor works, and light-house districts	3
River and harbor works	13
Post of Willets Point, United States Engineer School, and Battalion of Engineers	9
Missouri River Commission and river and harbor works	1
Public Buildings and Grounds and Washington Aqueduct	1
In arrest	1
Mississippi River Commission	1

Fortifications	2
Fortifications and California Débris Commission	1
Detached, with the Army in the field, with Light-House Establishment, and Commissioner of the District of Columbia	35
Total	123

The officers detached were on duty as follows:

Col. Peter C. Hains, Brig. Gen., U. S. Vols., commanding Second Brigade, First Division, First Army Corps	1
Col. George L. Gillespie, Brig. Gen., U. S. Vols., commanding Department of the East	1
Lieut. Col. Oswald H. Ernst, Brig. Gen., U. S. Vols., commanding First Brigade, First Division, First Army Corps	1
Lieut. Col. David P. Heap, engineer Third light-house district	1
Lieut. Col. William Ludlow, Brig. Gen. (now Maj. Gen.), U. S. Vols., commanding First Brigade, Second Division, Fifth Army Corps	1
Lieut. Col. William A. Jones, engineer Fourth and Fifth light-house districts	1
Lieut. Col. Andrew N. Damrell, engineer Seventh and Eighth light-house districts	1
Lieut. Col. Milton B. Adams, engineer Ninth and Eleventh light-house districts	1
Lieut. Col. William R. Livermore, Lieut. Col., U. S. Vols., chief engineer, Seventh Army Corps	1
Maj. William M. Black, Lieut. Col., U. S. Vols., chief engineer, on special duty under orders of the Major-General Commanding the Army	1
Maj. George McC. Derby, Lieut. Col., U. S. Vols., chief engineer, Fifth Army Corps	1
Maj. James L. Lusk, Lieut. Col., U. S. Vols., chief engineer, Second Army Corps	1
Capt. George W. Goethals, Lieut. Col., U. S. Vols., chief engineer, First Army Corps	1
Capt. John Millis, engineer secretary of the Light-House Board	1
Capt. John Biddle, Lieut. Col., U. S. Vols., chief engineer, Sixth Army Corps	1
Capt. Harry F. Hodges, Lieut. Col., U. S. Vols., recruiting the First Regiment, U. S. Volunteer Engineers	1
Capt. Edward Burr, Lieut. Col., U. S. Vols., commanding Engineer troops in the field	1
Capt. Lansing H. Beach, Engineer Commissioner of the District of Columbia	1
Capt. Graham D. Fitch, Maj., U. S. Vols., commanding Company C, Battalion of Engineers, in the field	1
Capt. William C. Langfitt, Maj., U. S. Vols., commanding Company A, Battalion of Engineers, in the field	1
Capt. Hiram M. Chittenden, Lieut. Col., U. S. Vols., chief engineer, Fourth Army Corps	1
Capt. David Du B. Gaillard, Col., U. S. Vols., organizing the Third Regiment, U. S. Volunteer Engineers	1
Capt. Charles S. Riché, Col., U. S. Vols., commanding the First Regiment, U. S. Volunteer Infantry	1
Capts. Thomas H. Rees and Eben E. Winslow, and Lieuts. Charles P. Echols, George M. Hoffman, William D. Connor, Sherwood A. Cheney, Harley B. Ferguson, Lytle Brown, and Robert D. Kerr, on duty with Engineer troops in the field	9
Capt. Charles L. Potter, Lieut. Col., U. S. Vols., chief engineer, Eighth Army Corps	1
Capt. Clement A. F. Flagler, Maj., U. S. Vols., engineer officer, First Division, First Army Corps	1
Lieut. Edgar Jadwin, Maj., U. S. Vols., organizing and recruiting the Third Regiment, U. S. Volunteer Engineers	1
Total	35

For some years past it has become manifest that an increase in the number of officers of the Corps of Engineers was urgently required for the efficient discharge of the largely increased duties and responsibilities devolving upon its members. The present organization of the Corps had remained unchanged since its establishment by the act of July 28, 1866, notwithstanding the fact that the duties, measured by the average annual expenditures, have increased nearly fivefold. The calls for

engineer officers for duty with the armies in the field during the war could be met only in part, owing to the necessity of keeping up the numerous works of fortification and of river and harbor improvements. Attention had been invited to this matter in several previous annual reports, and during the last session of Congress a bill providing for a gradual increase of 18 officers was introduced, but did not become a law until after the close of the fiscal year.

THE BOARD OF ENGINEERS.

The regulations for the government of the Corps of Engineers provide for a Board of Engineers, consisting of not less than three officers, to be designated by the Chief of Engineers with the sanction of the Secretary of War. This Board acts in an advisory capacity to the Chief of Engineers upon important questions of engineering. One of the principal duties of the Board is to plan or revise, under direction of the Chief of Engineers, projects of permanent fortifications for the defense of the United States.

The composition of this Board and its operations during the past fiscal year are given in its report.

(See Appendix No. 1.)

POST OF WILLETS POINT, N. Y.

The post was under the command of Maj. John G. D. Knight, Corps of Engineers, and at the close of the fiscal year garrisoned by 26 commissioned officers and 970 enlisted men, including officers and noncommissioned officers of the general staff; enlisted men of the Hospital Corps; parts of Companies B and D, Battalion of Engineers; Batteries K and L, Seventh Artillery, and Companies D, F, G, L, and M, Twenty-second New York Volunteer Infantry. Of the infantry, Company G reported for special post duty, the other companies for duty as "infantry supports."

New mess buildings for three companies were completed at a cost of $18,724.36; repairs to the wharf were made at a cost of $3,010, and other expenditures for labor and material amounted to $7,900.10.

A telegraph line was erected, connecting the post with Whitestone, N. Y., at a cost of $250, paid from the appropriation for contingencies of the Army.

May 16, 1898, by direction of the President, the Secretary of War ordered that, under paragraph 17 of the Regulations, the senior officer of engineers or of artillery, who may be present, shall command the post of Willets Point.

UNITED STATES ENGINEER SCHOOL.

The engineer officer in command of the post of Willets Point is the commandant of this school, and the captains commanding the engineer companies on duty at the post are the instructors.

The work of this school supplements the elementary knowledge of engineering given at West Point, and gives both practical and theoretical training during a course of two years.

After an existence of about nineteen years, it has been reorganized for a second time; and the regulations for the government of the school have been published to the Army in General Orders, No. 63, Headquarters of the Army, November 11, 1897.

The principal changes effected are two: But two years are devoted to the course of instruction instead of three, and when a graduate of the school is examined for promotion, his diploma is accepted as evidence of his proficiency in those subjects indicated therein as satisfactorily completed.

The operations of the school were suspended by the outbreak of war. Of the academic staff, only the commandant and one instructor remained at the school at the close of the fiscal year; of the student officers, all had been relieved.

Four engineer officers and fifteen officers of cavalry and infantry were under instruction, the latter in submarine mining only. Of the fifteen, five were relieved from duty August 18, 1897, after completing the course of instruction.

The special instruction in submarine mining of officers other than engineers has been carried on for eighteen years, but since the outbreak of war but two have given to the Government the benefit of such instruction by assisting in the mine defense of harbors.

BATTALION OF ENGINEERS.

The maximum authorized enlisted strength of the Battalion of Engineers is five companies of 150 men each. In accordance with section 3 of the act of Congress approved April 26, 1898, the organization of each company was, on April 27, 1898, raised to the maximum, and one first sergeant authorized for each company.

During the hostilities with Spain Company A has been serving with troops at the Philippine Islands; Companies C and E have been serving with the army operating in Cuba; Company D, with details from other companies (in all 153 men), has been detached for submarine-mining duty at nineteen harbors on the Atlantic, Gulf, and Pacific coasts, and Company B has been busily engaged at the Engineer Depot at Willets Point, receiving, storing, and distributing the vast amount of torpedo material, ponton equipage, siege materials, and instruments purchased and distributed from the depot, under the immediate direction of the commanding officer of the post, Maj. John G. D. Knight, Corps of Engineers, and in preparing and maintaining the submarine-mine defenses at the eastern entrance to New York Harbor.

ENGINEER DEPOT.

The engineer depot is the repository of tools and materials for ponton bridges, torpedo service, and instruments for surveys and astronomical work upon which the Corps of Engineers may be engaged.

The charge of the depot is distinct from the command of the post of Willets Point, at which it is situated, and of the Battalion of Engineers; but March 15, 1898, the Secretary of War directed the commanding officer of the post to aid the officer in charge of the depot, as far as possible, with the services of officers and enlisted men of his command, when so requested by the officer in charge of the depot.

Including 225 feet from West Point, 985 feet in all of bridge trains, exclusive of wagons except tool wagons and forges, were sent out for the use of the troops operating in Cuba and Porto Rico; in addition to these trains, about 1,000 additional feet was prepared ready for service, with wagons complete.

Tools and siege materials have been purchased sufficient for an actual working party of 30,000 men, not including reliefs.

Modern outfits for 44 mining casemates, 500 ground mine cases, 120 buoyant mine cases, nearly 500 miles of insulated submarine cable, 32 search light outfits, and miscellaneous submarine-mining materials have been distributed. Orders have been placed for 1,038 additional buoyant mine cases and for 8 more search lights. It is impracticable and unnecessary to specify in detail the tons of smaller articles of the torpedo service which have been specially made and distributed, in addition to the stores on hand at the outbreak of the war.

STATEMENT OF FUNDS.

Congress has appropriated as follows:

I. For engineer depot at Willets Point, N. Y., for fiscal year ending June 30, 1898	$10,000.00
June 30, 1898, expended and pledged	8,857.97
II. Torpedoes for harbor defense:	
1. Act. August 18, 1890, for "Torpedo experiments," etc.—	
July 1, 1897, balance unexpended	3,052.24
July 1, 1898, balance available	1,064.86
2. Act, June 6, 1896, for "Purchase of submarine mining materials and necessary appliances"—	
July 1, 1897, balance unexpended	5,749.23
July 1, 1898, balance available	12.74
3. Act, March 3, 1897, for "Purchase of submarine mining materials," etc.—	
July 1, 1897, balance unexpended	75,000.00
July 1, 1898, balance available	2,524.47
III. National Defense, act March 9, 1898:	
A. For Torpedo defense—	
Total of allotments	1,173,426.80
July 1, 1898, balance available	126,561.11
B. For "Equipment of engineer troops"—	
Total of allotments	14,000.00
July 1, 1898, balance available	162.98
IV. Torpedoes for harbor defense, January 1, 1899:	
May 14, 1898, amount allotted	25,000.00
July 1, 1898, balance available	1,233.71
V. Equipment of engineer troops, January 1, 1899:	
May 18, 1898, amount allotted	45,000.00
July 1, 1898, balance available	None.

NEW APPROPRIATIONS.

For Engineer Depot at Willets Point, N. Y., for fiscal year ending June 30, 1899	36,000.00

ESTIMATES.

There will be required for the fiscal year ending June 30, 1900, for the Engineer Depot at Willets Point, N. Y., the following:

For incidental expenses of depot	$5,000.00
For purchase of materials for use of United States Engineer School and for instruction of engineer troops	1,500.00
For purchase and repair of instruments	3,000.00
For library of United States Engineer School: For purchase and binding of professional works	500.00
Total	10,000.00

(See Appendix No. 2.)

FORTIFICATIONS.

During the fiscal year projects for permanent seacoast defenses were prepared, and approved by the Secretary of War, for Port Royal, S. C., St. Johns River, Florida, Tampa, Fla., and Sabine Pass, Tex., making 30 localities in the United States for which projects of permanent defenses have thus far been approved under the general scheme recommended in 1886 by the Board on Fortifications and other Defenses, generally known as the Endicott Board. At the close of the fiscal year the construction of permanent modern defensive works was in progress at 25 localities.

In consequence of the war with Spain and the possibilities of hostile attacks upon our coasts, urgent and pressing demands were made by Senators, Representatives, and local business interests for the immediate erection of seacoast batteries at numerous points not contemplated in the general scheme of national defense. When it is considered that the aggregate length of the coast of the United States, exclusive of Alaska, is 5,715 miles, and that more than 700 towns and villages on this extensive line can be attacked by ships drawing 10 feet or more of water, the practical impossibility of immediately and adequately defending every vulnerable point becomes readily apparent. Such an extensive development of works is not contemplated or necessary in a national system of defense which takes cognizance only of points important by reason of their wealth and population or of their strategical situation. In the absence of any available modern armament, the Secretary of War directed the immediate construction of temporary batteries, mounting old-style armament and siege guns, for the defense of a number of exposed localities, including some which are embraced in the scheme of national defense. The localities at which temporary batteries were ordered are Bar Harbor, Me.; Stonington, Bridgeport, and New Haven, Conn.; Port Royal and Georgetown, S. C.; Brunswick and Darien, Ga.; mouth of St. Johns River, St. Augustine, Miami, and Tampa, Fla., and Sabine Pass, Tex. In addition to the foregoing temporary batteries, preparations were made against possible hostile attacks, by overhauling, cleaning, and putting in serviceable condition the existing armament, and by temporarily mounting within them additional guns, at the following old-type works: Fort Knox, Fort Popham, Fort Trumbull, Fort Monroe, Fort Macon, Fort Pulaski, Fort Clinch, Fort Morgan, Fort Jackson, and forts in San Francisco Bay.

While no hostile attacks were made upon our coasts during the war with Spain, the operations of the American fleet on the coasts of Cuba and Porto Rico have amply demonstrated the value of coast defenses, including shore batteries and submarine mines, in resisting naval attacks. It may be confidently asserted that the completion of the projects upon which operations are now in progress will practically insure the safety of our principal harbors and seacoast cities against any attacks from the sea. One other important deduction may also be drawn from the results of the war, viz, the great value and efficiency of the rapid-fire gun. It is gratifying to report that not only has a considerable number of these rapid-fire guns been mounted during the year, but that provision has been made for the manufacture and emplacing of a large additional number.

Gun and mortar batteries.—Existing projects for seacoast defenses contemplate the emplacement of about 500 heavy guns of 8, 10, 12, and 16 inches caliber, of about 700 rapid-fire guns of various calibers, and of about 1,000 mortars. These figures are subject to slight changes as

minor revisions are made and additional localities included. The estimated approximate cost of the engineering work connected with the installation of this armament is $55,000,000.

Since the inauguration of the modern system of coast defense Congress has made appropriations for the construction of permanent gun and mortar batteries as follows:

Act of—		Act of—	
August 18, 1890	$1,221,000	March 3, 1897	$3,841,333
February 24, 1891	750,000	Allotted by the President from act of March 9, 1898	*3,786,000
July 23, 1892	500,000	May 7, 1898	3,000,000
February 18, 1893	50,000	July 7, 1898	2,562,000
August 1, 1894	500,000		
March 2, 1895	500,000		
June 6, 1896	2,400,000	Total	19,110,333

The appropriation contained in the deficiency act of July 7, 1898, while subsequent to the fiscal year, is included in the above table for purposes of exhibition.

The total number of seacoast guns and carriages of every kind reported by the Chief of Ordnance as having been provided for to date by his Department, and the corresponding emplacements provided for by the Engineer Department with the funds enumerated in the foregoing table, are shown in the following table:

Type of gun or carriage.	Total guns and carriages provided.	Total emplacements provided.
12-inch mortar carriages, model 1896	227	228
12-inch mortar carriages, model 1891	85	84
12-inch disappearing carriages, L. F., model 1897	22	22
12-inch disappearing carriages, L. F., model 1896	27	27
10-inch disappearing carriages, A. R. F., model 1896	3	3
10-inch disappearing carriages, L. F., model 1896	70	70
10-inch disappearing carriages, L. F., model 1894	35	35
8-inch disappearing carriages, L. F., model 1896	35	35
8-inch disappearing carriages, L. F., model 1894	26	26
12-inch gun-lift carriages, altered to barbettes	3	3
12-inch gun-lift carriages, model 1891	2	2
12-inch barbette carriages, model 1892	26	26
10-inch barbette carriages, model 1893	10	10
15-inch smooth-bore carriages altered for 8-inch rifle	21	21
8-inch barbette carriages, model 1892	8	9
6-inch disappearing carriages, model 1897	15	15
Fifteen-pounder rapid-fire carriages	80	80
Six-pounder rapid-fire field carriages and rampart mount	30	30
6-inch rapid-fire carriages (navy pattern, for Brown wire gun)	25	25
6-inch rapid-fire (Vickers Son & Maxim), pedestal mount	8	8
5-inch barbette carriages, on pillar mount, model 1896	32	32
5-inch rapid-fire (navy pattern, Brown wire gun)	25	25
4.7-inch rapid-fire (Armstrong pattern), pedestal mount	35	35
4-inch Driggs-Schroeder rapid fire	4	4

The foregoing table shows that provision has been made, including the deficiency act of July 7, 1898, for mounting 288 heavy seacoast guns, 254 rapid-fire guns, and 312 mortars, or about 57 per cent of the total projected armament of heavy guns, 36 per cent of the rapid-fire guns, and 31 per cent of the mortars. This armament is disposed at 71 localities in 29 harbors of the United States. Operations during the fiscal year were carried on under the acts of March 3, 1897, and May 7, 1898, and the various allotments made by the President from the appropriation for national defense, act of March 9, 1898.

The total number of emplacements provided for, and either completed or under construction, at the beginning of the fiscal year,

* Includes 21 8-inch B. L. rifles temporarily mounted on modified 15-inch smooth-bore carriages.

including the act of March 3, 1897, was given in the previous Annual Report, and is here repeated for purposes of comparison:

12-inch.	10-inch.	8-inch.	Rapid-fire.	12-inch mortars.
24	82	33	16	232

Under the act of May 7, 1898, construction was commenced upon the following emplacements:

12-inch.	10-inch.	8-inch.	12-inch mortars.
19	2	6	80

Under allotments made by the President from the appropriation for "National Defense," actof March 9, 1898, construction was commenced upon the following emplacements:

12-inch.	10-inch.	8-inch.	Rapid-fire.
31	18	a 41	46

a Includes twenty-one 8-inch B. L. rifles temporarily mounted on 15-inch smoothbore carriages.

A summation of the last three tables gives the following total number of emplacements completed or under construction at the close of the fiscal year:

12-inch.	10-inch.	8-inch.	Rapid-fire.	12-inch mortars.
74	102	80	62	312

When the diplomatic relations with Spain began to assume a threatening character, orders were given to push work with all possible energy, and to mount every available gun as fast as delivered. Operations were carried on with double, and in some cases three, shifts of workmen, and were pushed, regardless of weather and climate. The extraordinary efforts made have resulted in a most gratifying progress, especially in the number of guns mounted and available for service as compared with the previous fiscal year. The number of guns mounted at the beginning of the fiscal year, as shown by the last Annual Report, was as follows:

12-inch.	10-inch.	8-inch.	Rapid-fire.	12-inch mortars.
10	18	5	0	73

The status of works at the close of the year was as follows:

	12-inch.	10 inch.	8-inch.	Rapid-fire.	12-inch mortars.
Guns mounted	16	70	35	26	144
Ready for armament	27	28	7	16	64
Under construction	31	4	38	20	104
Total	74	102	80	62	312

A comparison of the last two tables shows that there were mounted during the year six additional 12-inch guns, fifty-two additional 10-inch guns, thirty additional 8-inch guns, twenty-six rapid-fire guns, and seventy-one additional 12-inch mortars.

Nearly all of the guns and mortars mounted at the close of the fiscal year had been transferred to the artillery for use and care under the provisions of Army Regulations, 1486. The care and service of this modern armament has largely increased the responsibilities devolving upon the artillery arm of the service, and has developed a defect in its organization which calls for prompt remedy through legislation by Congress. The new batteries either have been or will shortly be equipped with electric-light and power plants for lighting the magazines and passageways, and for operating the ammunition lifts. A still further extension of the application of electrical power is sought by the artillery arm and may be realized in the near future. The plants installed for this purpose by the Engineer Department, while as simple as circumstances will permit, demand for their proper care, preservation, and operation a greater degree of mechanical and electrical intelligence than can ordinarily be supplied by the enlisted men of the artillery. Instances of damage have already occurred where the care and operation of these plants have been intrusted to the enlisted men, and it has become necessary to provide temporarily for the employment of a number of civilian electrical and mechanical experts from the limited funds at the disposal of the Chief of Engineers. It is exceedingly desirable that all operations connected with the service of the modern batteries be conducted by men regularly enlisted and amenable to military discipline, and it is earnestly recommended that legislation be obtained providing for the enlistment in each battery of artillery of two or more machinist electricians at a rate of pay which will secure a class of men capable of properly caring for and operating the electric-light and power plants of modern batteries.

As new batteries are being completed and transferred to the artillery, questions of tactics and organization are arising which require careful consideration, in order that the highest efficiency may be realized from the new system of defenses. These defenses for any locality comprise not only gun and mortar batteries, usually separated from each other by intervening water areas, but submarine mines, search lights, and position-finding instruments, each separate element demanding a high degree of technical skill and involving the functions of the artillery arm and of the Engineers, Ordnance, and Signal departments. The complexity and variety of the elements of a perfected modern scheme of seacoast defense strongly suggest the necessity for a single head at each locality, who shall be responsible for the conduct of the defense and to whom all others shall be subordinate. In this connection attention is invited to the views of Brig. Gen. G. L. Gillespie, United States Volunteers, Colonel, Corps of Engineers, commanding Department of the East, upon the duties of a fortress commander as applied to the defenses of New York Harbor, printed as Appendix No. 3.

In order to continue the work of constructing seacoast defenses in accordance with approved projects, and to provide emplacements for the guns and carriages for which the Chief of Ordnance will submit estimates, an appropriation of $4,300,000 will be required, and this amount is requested.

Dynamite batteries.—Under the terms of the acts of September 22, 1888, and March 2, 1889, dynamite batteries were constructed, under the Ordnance Department, in past years at San Francisco Harbor,

California, and at Sandy Hook, New Jersey. By the act of July 7, 1898, an appropriation of $150,000 was made for the necessary parapets, magazines, etc., for the battery at San Francisco Harbor, and the work is now in progress. A temporary sand parapet with sandbag revetment was erected for the protection of the battery at Sandy Hook, with funds from the appropriation for "National Defense," act of March 9, 1898. The sandbags will of course rapidly decay, and for a permanent revetment and the proper completion of the battery the sum of $30,000 is necessary, and is requested.

Under the authority of the act of September 22, 1888, mentioned above, dynamite batteries have been ordered and will be erected by the Ordnance Department at Port Royal Harbor, South Carolina, and Fishers Island, eastern entrance to Long Island Sound. For the erection of the parapets for their protection, the construction of magazines, and completing the accessories of these batteries, the sum of $80,000 is necessary, and is requested.

Submarine mines.—During the past two years the question of a revision of the torpedo system has been under consideration by a special board of engineer officers. A number of improvements in the details of the materials and in the operation of the system were recommended after their superiority had been demonstrated by practical trials at the United States Engineer School at Willets Point. The labors of this board had been practically completed at the outbreak of the war, but unfortunately neither time nor funds were available for immediately replacing the old-style apparatus with the new and improved, and it became necessary to use the former to a large extent in mining the various harbors of the country for defense against attack during the war. At the outbreak of hostilities there were on hand a considerable number of mine cases and a limited quantity of operating apparatus, but no cable, explosives, search lights, or any of the multitude of miscellaneous minor articles needed to plant and operate the mines. Steps were immediately taken to procure as rapidly as possible all needed material, and for placing in position at every important harbor a preliminary line of mines. The total allotments from the appropriation for "National Defense" made by the President for the torpedo defenses of the country aggregated $1,540,000. In addition, the deficiency act of May 4, 1898, appropriated $50,000 for the purchase of material and $300,000 for planting and maintaining the mine fields. Only the more important items of torpedo material purchased with the foregoing funds can be here given. They comprise about 400 miles of single and multiple cable, 150 tons of explosives, 1,650 new torpedo cases, 44 electric search lights, 1,500 compound plugs for mines, 4,500 circuit closers and regulators, and 17 sets of casemate-operating apparatus. All of the above material, excepting the explosives, with a vast amount of minor articles, was purchased and distributed through the Engineer Depot at Willets Point, N. Y. At the close of the fiscal year submarine mines to the number of over 1,500 had been planted in twenty-eight different harbors, with all their cables, anchors, junction boxes, and the necessary operating apparatus installed. For the preservation and maintenance of the mine fields it was necessary to enforce special rules approved by the Secretary of War for the navigation of friendly vessels, involving the employment of a large number of tugs and boats with a numerous personnel, at an approximate average daily cost of nearly $3,000. In this connection some assistance was kindly furnished by boats belonging to the Light-House Establishment and to the Revenue-Marine Service, whose cooperation proved of material value.

The appropriation of $150,000 contained in the regular Fortification act of May 7, 1898, is being applied mainly to the construction of cable tanks and torpedo storehouses, which will be required after the war for the proper storage and preservation of the torpedo material purchased during hostilities. A number of the old casemates will require alterations and improvements to adapt them to the new-style apparatus, and it is proposed to apply a portion of the appropriation of the act of May 7, 1898, to this purpose.

To enable further alterations and improvements to be made in existing casemates, and for the construction of additional new casemates, cable tanks, and storehouses at a number of localities, an appropriation of $100,000 is requested.

Preservation and repair of fortifications.—During the year such minor repairs as were absolutely needed were made to existing works of old type, and a considerable number of old-type guns mounted on existing platforms in anticipation of attacks on our coasts. The increasing number of new works and the necessity of caring for and preserving their electric light and power plants and their ammunition lifts, trolleys, and other iron work, make frequent demands upon the appropriation for "Preservation and Repair of Fortifications."

For the proper care of, and for such repairs as may become necessary to, both the new and the old works an appropriation of $100,000 will be needed for the next fiscal year.

Sea walls and embankments.—The appropriation of $55,000 under this heading in the act of May 7, 1898, has been applied to completing the works of shore protection at Fort Morgan, Ala., and to protecting the newly acquired reservations at Hawkins Point and North Point, Maryland, both of which contain modern batteries. The only locality at present requiring action for the protection of the shore line against the erosion of the sea is at Fort Schuyler, for which an appropriation of $2,500 is requested.

Sites.—During the past fiscal year title has been obtained to sites required for seacoast defenses, in accordance with approved plans, at Boston, Mass.; eastern entrance to Long Island Sound; southern entrance to New York Harbor; Port Royal, S. C.; Key West, Fla.; Galveston, Tex., and Puget Sound, Washington. Negotiations are still in progress for the acquisition of sites at Boston, Mass.; Narragansett Bay, Rhode Island; eastern entrance to Long Island Sound, and Puget Sound, Washington. The acquisition of land for purposes of constructing seacoast defenses is in nearly every case attended by annoying delays, particularly where the aid of the courts must be invoked through the medium of condemnation proceedings. Whenever possible, title is obtained by direct purchase, but often the owners of land do not seem to be disposed to deal fairly with the Government, or else the titles to the land are involved, and in these cases resort to the courts with consequent delays is unavoidable. A number of important sites must still be acquired, and as all funds hitherto appropriated have been expended or pledged, an appropriation of $300,000 is requested to continue the acquisition of sites.

Section 355, Revised Statutes, provides that no public money shall be expended upon any site or land purchased by the United States for the purposes of erecting thereon any armory, arsenal, fort, fortification, navy-yard, custom-house, light-house, or other public building of any kind whatever until the written opinion of the Attorney-General shall be had in favor of the validity of the title, nor until the consent of the

legislature of the State in which the land or site may be, to such purchase, has been given.

To provide for the erection of temporary batteries during the war with Spain, for the defense of localities where no sites were owned by the United States, a joint resolution was passed by Congress, and approved by the President April 11, 1898, permitting the construction of temporary forts and fortifications upon land not owned by the United States, upon the written consent of the owners of the land, when, in cases of emergency, in the opinion of the President the immediate erection of such temporary fortifications is deemed important and urgent.

National defense.—The various allotments, and their objects, made by the President from the act of March 9, 1898, for purposes of "National Defense," were as follows:

March 17. Gun and mortar batteries	$2,725,000
March 17. Torpedo defenses	250,000
March 31. Emplacements for rapid-fire guns	90,000
March 31. Emergency purposes	60,000
April 2. Temporary emplacements for old and new guns at specified localities	150,000
April 2. Torpedo defenses	1,150,000
April 16. Temporary batteries at specified localities	65,000
April 21. Planting torpedoes	150,000
April 21. Emplacements for rapid-fire guns	50,000
April 23. Emplacements for 12-inch and 8-inch guns on barbette mounts	932,000
April 23. Cleaning ditches at Fort Delaware	6,000
May 28. Supplies for Engineer Depot, Manila	35,000
	5,663,000
May 4. Withdrawn	10,000
Net allotments	5,653,000

The following brief summaries of the detailed reports of district officers give a concise statement of the work at each locality during the fiscal year:

Defenses of coasts of Maine and New Hampshire.—Officer in charge, Maj. Richard L. Hoxie, Corps of Engineers; assistant, Lieut. George P. Howell, Corps of Engineers; Division Engineer, Brig. Gen. George L. Gillespie, U. S. Volunteers, Colonel, Corps of Engineers.

The older type fortifications in the district have been kept in repair as far as the limited funds would permit. Fort Preble, in Portland Harbor, contains a permanent artillery garrison. The remainder have been cared for by ordnance sergeants, excepting that Forts Knox, Popham, Scammel, Constitution, and battery at Portland Head have been occupied by troops during the latter part of the fiscal year 1898.

Work was continued on emplacements for five 10-inch guns for the defense of Portland Harbor, Maine. At the close of the year all of these were completed excepting a portion of the iron work, and all the guns were mounted.

Work was in progress on emplacements for two 12-inch B. L. R. on disappearing carriages under the contract provisions of the act of June 6, 1896. The progress made has not been satisfactory, and about the close of the year, after a portion of the concrete and one set of anchor bolts were in place, the contract was annulled, and the work will be completed by the United States. A substantial stone wharf with roadway leading thereto has been constructed at this locality.

Work has been in progress upon a battery for sixteen 12-inch mortars. All the platforms are completed, all the base rings set, and the

work of mounting the carriages commenced. The concrete work of one magazine is nearly completed. A cable tank for storage of submarine cable has been constructed, and a torpedo storehouse completed except the concrete floor. The construction of emplacements for two 12-inch guns, two 8-inch guns, and for eight 12-inch mortars, under the act of May 7, 1898, has been ordered, and at the close of the fiscal year the plans were being prepared.

At Portsmouth, N. H., work has been in progress, under contract, on emplacements for two 8-inch B. L. R. guns on disappearing carriages, including a mining casemate. The work is nearly completed and the guns mounted.

During the latter part of the fiscal year seven 15-inch S. B. guns were mounted on wooden platforms. The greater part of the cost of the latter, however, is provided for by an allotment from the appropriation for "National Defense."

The existing old armament on the Penobscot River was overhauled and put in condition for service.

Under allotments from the appropriation for "National Defense" the following work was done:

Emplacements for six 8-inch B. L. R. guns on disappearing carriages, Portland Harbor, Maine: Work was commenced at once upon the passage of the act, and at the close of the fiscal year practically all the preliminary work, including collection of the plant and material, construction of wharf, and the drilling of an artesian well, had been completed, and about 9,535 cubic yards of rock and 2,885 cubic yards of earth had been taken out, nearly completing the excavation for one battery of three guns. Preparations were being made at the close of the year to commence concreting. Temporary platforms for two 8-inch converted rifles were also constructed at this locality.

At Portland Harbor, Maine, work has been in progress upon an emplacement for one 6-inch rapid-fire gun. At the close of the year the excavation had been finished and the platform completed ready for the gun.

At Fort Popham, Me., temporary platforms for 15-inch S. B. guns were constructed and completed excepting a portion of the sand parapet. Guns and carriages were mounted. A concrete platform to accommodate an 8-inch B. L. rifle on a strengthened barbette carriage for 15-inch S. B. gun was also constructed, and the magazine nearly finished.

On the outer line of defense of Portsmouth Harbor, New Hampshire, there have been mounted two carriages for 15-inch S. B. guns, which carriages it is proposed to strengthen to carry 8-inch B. L. R. guns. The guns will be mounted when received, and suitable disposition will be made for the service of the ammunition.

At Bar Harbor, Me., the project for temporary defense provides for two 8-inch converted rifles and two 10-inch S. B. guns, all mounted on temporary wooden platforms. The consent of the owners of the sites has been secured for each place. At the close of the fiscal year the two 8-inch converted rifles were mounted and ready for service, and the two 10-inch S. B. guns were in process of mounting.

The project for the torpedo defense for Maine and New Hampshire includes the Penobscot and Kennebec rivers, Portland Harbor, Maine, and Portsmouth Harbor, New Hampshire. During April, 1898, mines were placed in three channels leading into Portland Harbor, and early in May in Portsmouth Harbor and in Kennebec and Penobscot rivers.

These operations included the equipment of mining casemates at each locality.

(See Appendix 4 A.)

Defenses of Boston, Mass.—Officer in charge, Col. Samuel M. Mansfield, Corps of Engineers; assistant, Maj. John Stephen Sewell, U. S. Volunteers, Lieutenant, Corps of Engineers.

The defenses include three works of old type, one of which is used as a torpedo depot for the storage of torpedo material.

At the close of the previous fiscal year there had been provided for under allotments from the regular fortification appropriations emplacements for eight 10-inch guns on disappearing carriages, a mortar battery for sixteen 12-inch mortars, and one for eight 12-inch mortars. All the 10-inch emplacements were essentially completed at the close of the fiscal year, and all guns mounted ready for service. The sixteen-mortar battery has been in the charge of troops since July 25, 1896, and operations during the year were limited to necessary repairs. The eight-mortar battery is being constructed by contract with funds allotted from the act of March 3, 1897, but owing to delays in acquiring title to the site active operations were not commenced until June, 1898. Two emplacements for 12-inch guns on disappearing carriages have been ordered under the act of May 7, 1898, and the preparation of plans is now in progress.

During the fiscal year a concrete cable tank for the storage of torpedo cable was made ready for service, and the torpedo material on hand overhauled and cleaned.

Negotiations were carried on throughout the year for the acquisition of the additional sites required to carry out the approved project for the defense of Boston Harbor. One site, comprising 33.13 acres, was purchased at a cost of $28,000, and a second site, comprising about 55 acres, has been partly acquired by purchase. Two other sites, one of which is owned by the city of Boston, still remain to be acquired. It is expected that one of these will be acquired by purchase during the ensuing fiscal year.

Under allotments from the appropriation for "National Defense" new emplacements have been provided for two 12-inch guns on barbette carriages, for three 12-inch guns on disappearing carriages, for two 10-inch guns on disappearing carriages, and for four rapid-fire guns. At the close of the fiscal year two rapid-fire guns were mounted, and platforms ready for the three 12-inch disappearing guns, for the two 10-inch disappearing guns, and for two additional rapid-fire guns. It is expected that all the emplacements under construction with funds derived from the appropriation for "National Defense" will be essentially completed by December 31, 1898.

In anticipation of the war with Spain, preparations were commenced early in April, 1898, for planting mines for the defense of Boston Harbor. A large quantity of cable, explosives, improvised mines, and other articles were purchased, mines loaded, and electrical appliances installed for operating the system. A total of ten grand groups of service-pattern mines were planted and maintained in effective condition to the close of the fiscal year.

(See Appendix 4 B.)

Defenses of southeast coast of Massachusetts and Rhode Island, at New Bedford, Mass., and Newport, R. I.—Officer in charge, Maj. Daniel W. Lockwood, Corps of Engineers; assistants, Capt. Charles H. McKinstry,

Corps of Engineers, to January 23, 1898; Lieut. William J. Barden, Corps of Engineers, from March 14 to April 15, 1898; Lieut. William B. Ladue, Corps of Engineers, since April 15, 1898, and Capt. Chester Harding, Corps of Engineers, since May 9, 1898; Division Engineer, Brig. Gen. George L. Gillespie, U. S. Volunteers, Colonel, Corps of Engineers.

The defenses include two permanent masonry works of old type, one of which is garrisoned. During the year a number of minor repairs were carried out at one of these works, including repairs to platforms for two 8-inch converted rifles and to increasing the earth cover of three magazines.

Under the regular fortification acts emplacements have been under construction for a battery of three 10-inch guns on disappearing carriages and for a battery of sixteen 12-inch mortars, the former by contract under the provisions of the act of June 6, 1896, and the latter by hired labor. Both batteries were completed during the fiscal year, the armament placed in position for service, and the batteries formally transferred to troops for use and care in June, 1898. An additional mortar battery for eight 12-inch mortars was authorized under the act of May 7, 1898, and plans and estimates were in progress of preparation at the close of the fiscal year.

During April and May a range-finder tower, completed during the previous fiscal year, was strengthened by a covering of timber and iron plates.

A concrete cable tank for the storage of torpedo cable was completed during the year.

Proceedings in condemnation for the acquisition of a much-needed site were instituted, and it is hoped that the title to the same will pass to the United States during the ensuing year.

Under allotments from the appropriation for "National Defense," emplacements were commenced in March and April for two 10-inch guns on disappearing carriages; for two 8-inch guns on disappearing carriages; for three rapid-fire guns, and for two 12-inch guns on non-disappearing carriages. The platforms for the two 10-inch guns were both completed before the close of the fiscal year, and one gun mounted for service. The two platforms for 8-inch guns were also completed before the close of the fiscal year. The rapid-fire emplacements are designed for one 6-inch and for two 4.72-inch guns. All three emplacements were completed at the close of the year and awaiting delivery of their armament, which will be mounted immediately upon its receipt. The construction of the two emplacements for 12-inch guns involved the construction of a wharf, which, as well as the excavation for the battery, was nearing completion at the end of the year.

An existing 15-inch smoothbore-gun emplacement is being prepared to receive an 8-inch B. L. rifle. The necessary changes were completed, and the gun will be mounted as soon as received.

It is expected that all works under allotments from the appropriation for "National Defense" will be completed during the present working season.

During the months of April and May the entrances to Narragansett Bay were closed by mines and special rules for navigation put in operation. The mine fields have been maintained and patrolled to the end of the fiscal year. At New Bedford, Mass., torpedo material was accumulated and preparations made for planting mines, but none were actually placed in position before the close of the year.

(See Appendix C 4.)

Defenses of eastern entrance to Long Island Sound and coast of Connecticut.—Officer in charge, Maj. Smith S. Leach, Corps of Engineers; assistant, Lieut. William J. Barden, Corps of Engineers, to March 14, 1898, and since April 15, 1898; Division Engineer, Brig. Gen. George L. Gillespie, U. S. Volunteers, Colonel, Corps of Engineers.

The defenses include two masonry works of old type, one of which has been garrisoned throughout the year, and the other for a short period as a result of the war. Platforms for three 15-inch smoothbore guns were prepared under an allotment from the appropriation for "National Defense," and the guns mounted by the troops. Eleven 10-inch smoothbore guns were dismounted and transported to other points for the protection of the principal coast towns.

The new works of defense, under construction with funds derived from the regular fortification appropriations, comprise emplacements for two 12-inch guns on disappearing carriages and for two 10-inch guns on disappearing carriages. All are being constructed by contract under the provisions of the act of June 6, 1896. The contract for the 10-inch emplacements includes a mining casemate. The contract for the two 12-inch emplacements has been completed, and the battery awaits its armament. The platforms of the 10-inch emplacements have been completed and one gun is mounted. Considerable work still remains to be done, however, owing to the dilatory methods of the contractor.

Under the act of May 7, 1898, emplacements have been authorized for two 12-inch guns and for two 8-inch guns, all on disappearing carriages, and for eight 12-inch mortars. Plans and estimates for these new works were partially completed at the close of the fiscal year.

During the year a site was acquired at Napatree Point, Rhode Island, and condemnation proceedings were in progress for the acquisition of a second site at the western end of Fishers Island, N. Y.

With allotments from the appropriation for "National Defense," act of March 9, 1898, emplacements were commenced in March and April for two 10-inch guns on disappearing carriages, for one rapid-fire gun, and for two 8-inch B. L. rifles on 15-inch smoothbore carriages, the latter so planned as to be capable of receiving later the approved type of disappearing carriage. The 10-inch emplacements were essentially completed at the close of the fiscal year, or within a period of a little over three months. Their armament had not been delivered at the close of the year. The rapid-fire emplacement has been completed, and a 4.72-inch gun mounted ready for service. Operations were in progress at the close of the year upon the emplacements for 8-inch guns on barbette carriages, with one platform ready for armament.

For the defense of New Haven temporary batteries for six 10-inch smoothbore guns were constructed under the appropriation for "National Defense." Similar temporary batteries for four and one gun, respectively, were constructed at Bridgeport and Stonington. Submarine mines were planted for the defense of New Haven Harbor, and the mine fields maintained and patrolled to the end of the fiscal year.

(See Appendix 4 D.)

Defenses of New York.—Officer in charge at eastern entrance to harbor, on islands in harbor, and on Staten Island, Maj. Henry M. Adams, Corps of Engineers; assistants, Lieut. Robert R. Raymond, Corps of Engineers, and Lieut. James F. McIndoe, Corps of Engineers, the latter since April 11, 1898. Torpedo defenses at eastern entrance in the charge of Maj. John G. D. Knight, Corps of Engineers, since April 6, 1898. Officer in charge of defenses on Long Island and at Sandy

Hook, Brig. Gen. William Ludlow (now Maj. Gen.), U. S. Volunteers, Lieutenant-Colonel, Corps of Engineers, until April 21, 1898; after that date, Maj. Henry M. Adams, Corps of Engineers; assistants, Lieut. Robert McGregor, Corps of Engineers, and Lieut. Edwin R. Stuart, Corps of Engineers, the latter since April 16, 1898. Division Engineer, Brig. Gen. George L. Gillespie, U. S. Volunteers, Colonel, Corps of Engineers.

The defenses include a number of masonry works of old type to which minor repairs were made during the year as far as permitted by the limited funds available.

Eastern entrance to harbor: At the beginning of the year two emplacements for 10-inch guns on disappearing carriages had been nearly completed and work had been begun upon one 12-inch and one 8-inch emplacement, both for disappearing carriages. These have all been completed except minor fittings for the 12-inch emplacement. The armament of the two 10-inch emplacements and of the one 8-inch emplacement is in position for service; that of the 12-inch emplacement had not been delivered at the close of the fiscal year. Eight platforms for 12-inch mortars have been constructed, and the mortars mounted. Work was also begun upon two emplacements for 5-inch rapid-fire guns on balance pillar mounts. In addition to the above the modern defenses include a mortar battery for sixteen 12-inch mortars, and emplacements for two 10-inch guns and for one 8-inch gun on disappearing carriages, which are completed and armed. With funds from the act of May 7, 1898, the construction of two emplacements for 12-inch guns on disappearing carriages was commenced.

Under an allotment from the appropriation for "National Defense," provision has been made for mounting one 8-inch B. L. rifle on modified 15-inch carriage. The emplacement is ready for its armament.

The channel was defended by 59 submarine mines planted in April and May. Special regulations for navigation were promulgated and the mine fields maintained and patrolled to the close of the fiscal year.

Southern entrance to harbor: On Staten Island four emplacements for 10-inch guns on disappearing carriages, nearly completed at the date of the last Annual Report, have been completed and armed. The construction of two emplacements for 12-inch guns on disappearing carriages was commenced with funds appropriated by the act of May 7, 1898. The defenses also include five emplacements for 8-inch guns on disappearing carriages, completed and armed prior to the fiscal year.

At the beginning of the fiscal year the modern defenses on Long Island and Sandy Hook consisted of sixteen 12-inch mortars, two 12-inch guns on lifts, and five 10-inch guns on disappearing carriages, all completed, and two 12-inch guns and four 10-inch guns on disappearing carriages, under construction. During the year the four 10 inch emplacements, three of which were built by contract under the provisions of the act of June 6, 1896, were completed and armed, and the two 12-inch emplacements nearly completed and ready for armament. Construction was also begun upon one emplacement for a 5-inch rapid-fire gun, and the same completed and armed. Under the act of May 7, 1898, emplacements have been authorized for two 12-inch guns on disappearing carriages and for eight 12-inch mortars.

The reservation at Fort Wadsworth was extended by the purchase of an additional tract of land required for modern works, at a cost of $60,000.

The breach in the Sandy Hook peninsula was closed under the

special appropriation for this purpose contained in the act of March 3, 1897. At the close of the fiscal year 57,165 tons of riprap stone had been put in place and the work practically completed.

Under allotments from the appropriation for "National Defense," emplacements were authorized on Staten Island for two 12-inch guns on disappearing carriages, for two 4.7-inch rapid-fire guns, for two 8-inch B. L. rifles on modified 15-inch carriages, and for a temporary battery of three 8-inch converted rifles. At the close of the fiscal year the rapid-fire emplacements were completed and armed and the 12-inch emplacements sufficiently advanced to be ready for armament. The temporary battery is completed and ready for armament.

Under allotments from the appropriation for "National Defense," emplacements were authorized on Long Island and Sandy Hook for three 10-inch guns on disappearing carriages, for two 12-inch guns on disappearing carriages, and for two 12-inch guns on nondisappearing carriages, and for four rapid-fire guns. At the close of the fiscal year two rapid-fire emplacements were completed and armed with 4.7-inch guns, and two platforms for 10-inch guns on disappearing carriages were ready for armament. The pneumatic gun battery was provided with a sand parapet and sand-bag retaining walls, and temporary emplacements constructed for two siege guns and one rapid-fire gun.

It is expected that all works under allotments from the appropriation for "National Defense" will be completed before the close of the calendar year.

Submarine mines were planted at the Narrows and at the Sandy Hook entrance, about 250 mines having been placed in position. Both mine fields were maintained and patrolled for the enforcement of the special regulations for navigation to the close of the fiscal year.

(See Appendix 4 E.)

Defenses of the Delaware River.—Officer in charge, Lieut. Col. Charles W. Raymond, Corps of Engineers, with Maj. Spencer Cosby, U. S. Volunteers, Lieutenant, Corps of Engineers, and Lieut. Sherwood A. Cheney, Corps of Engineers, under his immediate orders, the latter from September 30, 1897, to April 10, 1898.

The defenses include one masonry work of old type which was garrisoned for a portion of the year as a result of the war.

The modern works of defense provided for under regular fortification appropriation acts consist of a battery for three 12-inch and three 10-inch guns on disappearing carriages, one battery of three 12-inch disappearing guns, a battery for two 5-inch rapid-fire guns, and a battery of sixteen 12-inch mortars.

The battery of six 10-inch and 12-inch disappearing guns is completed, the guns and carriages are mounted, and the ammunition hoists, electric lighting system, cranes, etc., are in full working order. The construction of the parados in rear of the battery is still in progress, 33,984 cubic yards of earth and sand having been placed in it out of a total estimated quantity of 42,000 cubic yards. The total cost of this battery up to June 30, 1898, was $241,692.38. In addition, a road was built from the rear of the battery to the wharf at a cost of $3,702.53. Mounting the six guns and carriages cost $6,665.84; the cost of the parados up to June 30, 1898, was $9,862.28, and the latrines in parados $1,209.42.

The battery of three 12-inch guns on disappearing carriages had its concrete foundations carried up solidly from above the piles to just below the reference of the floors 10.5. Thus far the funds available

have permitted the construction of the foundations only, but the battery will be completed during the coming fiscal year with funds appropriated by the deficiency act of July 7, 1898.

Preliminary work for the construction of the battery for sixteen 12-inch mortars was commenced on June 24, 1897, and has been steadily continued, except when interrupted by the weather, during the fiscal year. On June 30, 1898, all masonry work, except the blast slopes above the pits, was completed and the battery was ready for service. All sixteen mortar carriages and eight mortars had been mounted; the other eight mortars were to be mounted as soon as received. Work on the sand embankment around the pits and magazines was in progress, and the systems for lighting the battery by electricity and for handling ammunition were being installed. Up to June 30, 1898, $130,461.30 had been expended on this battery.

The two emplacements for 5-inch rapid-fire guns on balanced-pillar mountings were completed and ready for the guns and carriages in August, 1897. The battery contains 2,266 cubic yards of masonry and 6,944 cubic yards of earth embankment, and cost up to June 30, 1898, $19,259.54. The two guns and carriages have not yet been received.

A fireproof torpedo shed for the storage of the torpedo material required by the approved project of submarine-mine defense was completed during the year.

With funds allotted from the appropriation for "National Defense," act of March 9, 1898, two emplacements for 8-inch guns on disappearing carriages were begun in March, 1898, and two emplacements for 12-inch guns on barbette carriages in May, 1898. On June 30, 1898, the masonry of the two 8-inch emplacements was practically completed and the guns and carriages were mounted and ready for service. The masonry work of the two 12-inch emplacements was more than half completed.

Two 4.72-inch rapid-fire guns, purchased in England, were received on April 23, 1898. Twelve days later they had been mounted on temporary platforms ready for service. It is proposed to build permanent emplacements for them with funds allotted from the appropriation for "National Defense." The project for these emplacements was approved June 14, 1898, and arrangements were at once made to start the work of construction.

Submarine mines for the defense of the Delaware were planted in April and May, 1898. With the exception of four that had become detached, all were in position at the end of the fiscal year. The torpedo casemates are fitted with new apparatus and are in full working order. Two search lights are mounted, a temporary loading shed is fitted up, a base line is laid out and connected by telephone with the casemate, and patrol boats are maintained day and night to protect the mine fields.

(See Appendix 4 F.)

Defenses of Baltimore, Md.—Officer in charge, Brig. Gen. Peter C. Hains, U. S. Volunteers, Colonel, Corps of Engineers, having under his immediate orders Lieut. Charles W. Kutz, Corps of Engineers, until October 22, 1897, and from April 1, 1898, to June 10, 1898. From October 22, 1897, to April 1, 1898, and from June 10, 1898, to the end of the fiscal year they were in the temporary charge of Lieut. Charles W. Kutz, Corps of Engineers.

The defenses of Baltimore, built, building, and proposed, are located at five points on the Patapsco River. Three of the points are new sites, of which two are occupied by modern works and garrisoned. The third

new site is under the care of a watchman. The two old works are both garrisoned; one of them is in the course of preparation to receive modern-type guns, but no new work is contemplated at the site of the other.

Under the contract provisions of the act of June 6, 1896, emplacements have been provided for a battery of eight 12-inch mortars, a battery of one 12-inch and three 8-inch guns on disappearing carriages, and for two 5-inch rapid-fire guns on balance-pillar mount. These works were all completed and armed during the year except the rapid-fire battery, whose final completion is delayed pending arrival of the carriages.

The protection of two of the new sites against erosion by the sea has been commenced with funds appropriated by the act of May 7, 1898, and will be completed during the present working season.

Under allotments from the appropriation for "National Defense," act of March 9, 1898, emplacements were authorized for two 12-inch guns on disappearing carriages, for two 12-inch guns on nondisappearing carriages, and for two 4.72-inch rapid-fire guns. At the close of the fiscal year the two emplacements for disappearing carriages were completed in all essential details, and awaiting their armament. The platforms of the two emplacements for nondisappearing carriages were ready for armament, and work was being rapidly pushed, with the expectation that the battery would be finished within two months. The rapid-fire battery is entirely completed except the armament, which had not been delivered.

The channel leading to Baltimore was obstructed by submarine mines, which were kept in condition for service to the close of the year.

(See Appendix 4 G.)

Defenses of Washington, D. C.—Officer in charge, Lieut. Col. Charles J. Allen, Corps of Engineers; assistant, Maj. Jay J. Morrow, U. S. Volunteers, Lieutenant, Corps of Engineers.

The defenses include two works of old type, one of which is of masonry construction. Minor repairs were made during the year as found necessary, and as far as permitted by the funds available for this purpose.

At the close of the previous fiscal year emplacements for three 10-inch guns on disappearing carriages had been completed and the guns mounted, and operations were in progress upon an additional emplacement for a 10-inch gun on disappearing carriage and for three emplacements for 8-inch guns on disappearing carriages, the latter by contract under the provisions of the act of June 6, 1896. At the close of the fiscal year all the foregoing emplacements were completed and the guns mounted ready for service.

Under an allotment from the appropriation for the "Board of Ordnance and Fortification," supplemented by an allotment from the appropriation for "Gun and Mortar Batteries," two sections of experimental parapets were constructed, one of sand with a retaining wall of steel rails, the other of the type form, with a view to testing their relative efficiency under the fire of a 10-inch gun, which is to be mounted on a nondisappearing carriage on a platform specially constructed for this purpose. At the close of the year this work had been completed, but the war with Spain has thus far prevented the carrying out of the projected experiments.

A mortar battery for eight 12-inch mortars has been authorized under the act of May 7, 1898, and the preparation of plans and estimates was in progress at the close of the fiscal year.

A concrete cable tank was built during the year and a torpedo store-

house nearly completed for the storage of cable and other material required for the submarine-mine defenses.

Under allotments from the appropriation for "National Defense," emplacements were authorized for two 10-inch guns on disappearing carriages and for two 4-inch rapid-fire guns. At the close of the fiscal year the 10-inch emplacements were well advanced and ready for their armament. The rapid-fire emplacements were nearing completion and their armament was being put in position.

The 10-inch gun on nondisappearing carriage intended for testing the experimental parapet was mounted upon a temporary platform so as to be available for service in case of an emergency.

Submarine mines were planted in the channel and the mine fields patrolled and kept in effective condition.

(See Appendix 4 H.)

Defenses of Hampton Roads, Va.—Officer in charge, Maj. Thomas L. Casey, Corps of Engineers; assistants, Lieut. Frank A. Wilcox, First Infantry, from April 20, 1898, and Lieut. Edward H. Schulz, Corps of Engineers, from April 9 to May 19, 1898; Division Engineer, Brig. Gen. Peter C. Hains, U. S. Volunteers, Colonel, Corps of Engineers.

The defenses include two inclosed masonry works of old type, one of which is only partially completed. Various minor repairs were made during the year for their preservation.

At the close of the previous fiscal year emplacements for three 10-inch guns on disappearing carriages had been completed and armed, and operations were in progress upon a mortar battery for sixteen 12-inch mortars and an additional emplacement for a 10-inch gun on disappearing carriage. During the year the mortar battery was finished and armed and the additional 10-inch emplacement practically completed and in readiness for its armament. An 8-inch B. L. rifle on nondisappearing carriage, which had for some time been mounted upon the open beach for purposes of target practice, was mounted behind the cover of one of the mining casemates and provided with a magazine, making it a part of the permanent project of defense.

A system of electric lighting was installed in the mortar battery and the completed 10-inch emplacements. Two shelter houses were built at the ends of the horizontal base line for the protection of range-finding instruments.

The construction of three emplacements for 12-inch guns on disappearing carriages was authorized under the act of May 7, 1898, and plans for these were under consideration at the close of the fiscal year.

An additional mining casemate was constructed during the year and was occupied and used in connection with the submarine-mine defense of Hampton Roads.

Under allotments from the appropriation for "National Defense," emplacements were authorized for three 10-inch guns on disappearing carriages, for four 4.72-inch rapid-fire guns, and for four 8-inch B. L. rifles on nondisappearing carriages, the last being of a temporary character.

At the close of the fiscal year platforms had been completed for two 10-inch guns, for four 8-inch guns, and for three rapid-fire guns. Three 8-inch guns and three rapid-fire guns were mounted ready for service.

Additional protection was provided for the magazines of the water battery by banking up sand in their front.

The channel was obstructed by 108 submarine mines, and special regulations for navigation enforced. The mine fields were patrolled

day and night, and such repairs as were found necessary made from time to time.

(See Appendix 4 I.)

Defenses of the coast of North Carolina.—Officer in charge, Capt. William E. Craighill, Corps of Engineers; assistants, Lieut. Edgar Jadwin, Corps of Engineers, until October 12, 1897, and Lieut. John C. Oakes, Corps of Engineers, since September 30, 1897; Division Engineer, Brig. Gen. Peter C. Hains, U. S. Volunteers, Colonel, Corps of Engineers.

The defenses include three works of old type, two of which are in ruins.

At the close of the previous fiscal year emplacements for three 8-inch guns on disappearing carriages were under construction, by contract, under the provisions of the act of June 6, 1896. These were completed and armed during the year. A mortar battery of eight 12-inch B. L. mortars was authorized under the act of May 7, 1898, and plans for the same have been completed.

Under allotments from the appropriation for "National Defense," the construction of a fourth emplacement for an 8-inch gun on disappearing carriage was authorized, and was entirely completed and armed before the close of the fiscal year. In connection with this emplacement provision was made for a 5-inch rapid-fire gun on balance-pillar mount, which can be installed as soon as it can be furnished.

Emplacements were also authorized for two 12-inch guns on nondisappearing carriages, and for one 4.72-inch rapid-fire gun on pedestal mount. At the close of the year the 12-inch platforms were completed and the battery well advanced. The rapid-fire emplacement is finished and awaiting its armament.

Submarine mines were placed in the Cape Fear River at the outbreak of the war and maintained in condition for service to the end of the year.

(See Appendix 4 J.)

Defenses of the coast of South Carolina.—Officers in charge: Maj. Frederic V. Abbot, Corps of Engineers, until September 15, 1897; Lieut. Edwin R. Stuart, Corps of Engineers, from September 15 to October 9, 1897, and Maj. Ernest H. Ruffner, Corps of Engineers, from October 9, 1897. Assistants, Lieut. Edwin R. Stuart, Corps of Engineers, until September 15, 1897, and from October 9 to November 10, 1897; Lieut. Harley B. Ferguson, Corps of Engineers, from September 30, 1897, to April 11, 1898; Lieut. Charles Keller, Corps of Engineers, from April 11, 1898, and Lieut. Edward H. Schulz, Corps of Engineers, from May 20, 1898. Division Engineer, Brig. Gen. Peter C. Hains, U. S. Volunteers, Colonel, Corps of Engineers.

The defenses include four old-type works, three of which are in the charge of ordnance sergeants, and the fourth, of the Light-House Establishment.

At the close of the previous fiscal year the sixteen-mortar battery was completed in all essential details and eight mortars were in position. During the year the remaining details of the battery were completed and all the armament placed in position. The three 10-inch gun emplacements under construction, by contract, under the provisions of the act of June 6, 1896, were finished, and a fourth 10-inch emplacement built under a separate contract. Four 10-inch guns on disappearing carriages were mounted by the artillery. Both the mortar battery and the gun battery were transferred to the troops under the provisions *of Army Regulations, 1486.*

Under allotments from the appropriation for "National Defense" emplacements were authorized at Charleston, S. C., for two 12-inch guns, one on disappearing carriage, one on nondisappearing carriage; for two 4.72-inch rapid-fire guns, and for one 6-inch rapid-fire gun. At the close of the year the platform for one 12-inch gun had been finished, and good progress made on the battery. Two 4.72-inch rapid-fire emplacements were completed. No work had been done on the 6-inch rapid-fire emplacement at the close of the fiscal year, but it is expected that it will be finished before the arrival of the armament.

A project was prepared by The Board of Engineers for the defense of Port Royal, S. C., and at the outbreak of the war steps were taken to secure some land for the erection of permanent batteries. Sufficient land for the object in view was fortunately acquired in a short time, and the construction of emplacements for two 10-inch guns and for two 4.72-inch rapid-fire guns authorized under the appropriation for "National Defense." At the close of the year the rapid-fire guns were mounted and the platforms for the 10-inch guns ready for their armament. Temporary batteries were also ordered for two siege guns and for two 8-inch B. L. rifles on 15-inch smoothbore carriages. The siege battery was completed and armed, but the guns were subsequently removed for use in the campaign in Cuba. Construction was in progress on the battery of 8-inch guns at the close of the year, and the same will be soon completed.

Temporary batteries for four siege guns were ordered constructed for the defense of Georgetown, S. C. These were completed and armed, but the guns were subsequently removed for use in Cuba, being replaced by field guns.

The entrance to Charleston Harbor was defended by submarine mines, placed in position at the commencement of the war. These were kept in order and the mine fields patrolled to the end of the year.

Preparations were made for the torpedo defense of Port Royal Harbor and submarine-mine material accumulated, but no mines had been planted at the close of the year.

(See Appendix 4 K.)

Defenses of the coast of Georgia and Cumberland Sound, Georgia and Florida.—Officers in charge, Capt. Oberlin M. Carter, Corps of Engineers, until July 20, 1897, and Capt. Cassius E. Gillette, Corps of Engineers, since July 20, 1897; assistants, Lieut. Henry S. Morgan, Corps of Engineers, since September 30, 1897, and Lieut. Charles S. Bromwell, Corps of Engineers, since April 13, 1898; Division Engineer, Brig. Gen. Peter C. Hains, U. S. Volunteers, Colonel, Corps of Engineers.

The defenses include three masonry works of old type. The armament of one of these was overhauled and put in condition for service at the outbreak of the war with Spain. A number of minor repairs were made during the year from the appropriation for the preservation and repair of fortifications.

The battery of four 8-inch guns on disappearing carriages, under construction, by contract, under the provisions of the act of June 6, 1896, was substantially completed and the guns mounted before the end of the year. A system of electric lighting remains to be installed.

A cable tank was constructed for the storage of the torpedo cable required for the submarine-mine defense of Savannah, Ga.

The construction of a mortar battery for eight 12-inch mortars was authorized under the act of May 7, 1898, and the preparation of plans is now in progress.

Under allotments *from the appropriation for* "National Defense" per-

manent emplacements were authorized for two 12-inch guns on nondisappearing carriages and for three rapid-fire guns, two of 4.7-inch and one of 6-inch caliber. At the close of the fiscal year the rapid-fire emplacements were completed and two 4.7-inch guns mounted. Active construction was under way on the 12-inch emplacements, and these will be completed before the close of the calendar year.

For the defense of Brunswick and Darien, Ga., and Fernandina, Fla., temporary batteries mounting three 10-inch smoothbore, six 100-pounder Parrott, and four siege guns were constructed at a number of entrances to the inside water route. These were provided with sand parapets, wooden platforms, and field magazines.

An 8-inch B. L. rifle on nondisappearing carriage was temporarily mounted on a concrete platform for the defense of Savannah. The existing old-type armament at Forts Pulaski and Clinch was overhauled, repaired, and put in condition for service. At the latter place a platform for an 8-inch B. L. rifle, to be mounted upon a 15-inch smoothbore carriage, was under construction at the close of the year.

Submarine mines were planted for the defense of Savannah and Cumberland Sound, and maintained in condition for service to the end of the year.

(See Appendix 4 L.)

Defenses of the east and west coasts of Florida.—Officer in charge, Lieut. Col. William H. H. Benyaurd, Corps of Engineers; assistants, Capt. Robert P. Johnston, U. S. Volunteers, Lieutenant, Corps of Engineers, until February 1, 1898, and since June 19, 1898, and Maj. William W. Harts, U. S. Volunteers, Lieutenant, Corps of Engineers, since April 28, 1898.

These consist of one work of the older type, four works of temporary defense constructed during the year, and a battery of two 6-inch rapid-fire guns and two batteries of two 8-inch rifles, on which construction was commenced during the year. The preparation of plans and estimates for a battery of eight 12-inch mortars was also under way at the close of the year.

Fort Marion, at St. Augustine, Fla., the old-type work, is of little value for defensive purposes. It is a most interesting relic of the Spanish invasion of America, and has been cared for and preserved as such under the charge of an ordnance sergeant.

With funds provided by the appropriation for "National Defense," act of March 9, 1898, temporary batteries for mounting field and siege guns were built near the mouth of the St. Johns River, at St. Augustine, at Miami, and at Tampa Bay. The construction of two emplacements for 8-inch breech-loading rifles at St. Johns River, two emplacements for 8-inch breech-loading rifles, and two emplacements for 6-inch breech-loading rapid-fire guns, at Tampa Bay, was commenced.

Plans and estimates were under preparation for a battery of eight 12-inch mortars at Tampa Bay, proposed to be constructed with funds appropriated by the act of May 7, 1898.

An emergency system of mine defense was provided for the St. Johns River, and preparations for placing mines in Tampa Bay were under way.

(See Appendix 4 M.)

Defenses of Key West, Fla.—Officers in charge, Lieut. Col. William H. H. Benyaurd, Corps of Engineers, until February 1, 1898, and Capt. Charles H. McKinstry, Corps of Engineers, since February 1, 1898; assistant, Lieut. Robert P. Johnston, Corps of Engineers, until June

19, 1898; Division Engineer, Brig. Gen. Peter C. Hains, U. S. Volunteers, Colonel, Corps of Engineers, since February 1, 1898.

The defenses include one masonry work of old type, in which platforms for two 15-inch smoothbore guns and for three 8-inch converted rifles were constructed and the guns mounted during the fiscal year. A number of minor repairs necessary for the preservation of the work were also made.

Emplacements for four 10-inch and two 8-inch guns on disappearing carriages and for eight 12-inch mortars are being constructed by contract under provisions of act of June 6, 1896. Contract entered into March 4, 1897; approved March 27, 1897. These emplacements were to be completed by January 1, 1898; time for completion has been extended until September 7, 1898.

The gun emplacements are practically finished except 70,000 yards sand fill, which remain to be placed; 800 yards of concrete remain to be placed at mortar battery, and about 78,000 yards of sand fill. The six guns, five of the gun carriages, and six of the mortar carriages have been received during the year. Three 10-inch and two 8-inch guns and six mortar carriages have been mounted complete.

Mining casemate and cable gallery were practically completed during the year.

Two additional sites for fortifications were purchased.

Under allotments for the appropriation for "National Defense," emplacements for two 12-inch guns on nondisappearing carriages and for two 4.7-inch rapid-fire guns were authorized. At the close of the fiscal year the 12-inch emplacements were in progress and the rapid-fire guns mounted temporarily, pending completion of their permanent emplacements, upon which work had been begun.

Submarine mines were planted for the defense of the harbor, and the mine fields patrolled and kept in repair to the close of the year.

(See Appendix 4 N.)

Defenses of Pensacola, Fla.—Officer in charge, Maj. Frederick A. Mahan, Corps of Engineers; assistant, Lieut. James P. Jervey, Corps of Engineers; Division Engineer, Brig. Gen. Peter C. Hains, U. S. Volunteers, Colonel, Corps of Engineers.

The defenses include two masonry works of old type, which received a number of minor repairs during the year.

During the year a battery of four 10-inch guns on disappearing carriages was completed in all details, the guns mounted, and the battery transferred to the artillery for use and care. Work was in progress during the year upon a mortar battery for eight 12-inch mortars. At the close of the year the masonry work had been finished, all the base rings set, and three carriages completely mounted and the others well under way. The principal remaining item of work is the sand fill, which it is expected to complete before the close of the calendar year.

Under allotments from the appropriation for "National Defense," emplacements were authorized for two 12-inch guns on disappearing carriages, for two 8-inch guns on disappearing carriages, and for two 4.7-inch rapid-fire guns. At the close of the year the rapid-fire guns were mounted and the 12-inch and 8-inch platforms finished, with every prospect of the entire completion of the batteries before the close of the calendar year.

Submarine mines were planted and maintained in condition for service to the close of the year.

(See Appendix 4 O.)

Defenses of Mobile and Mississippi Sound.—Officer in charge, Maj. William T. Rossell, Corps of Engineers; assistant, Lieut. James B. Cavanaugh, Corps of Engineers; Division Engineer, Brig. Gen. Peter C. Hains, U. S. Volunteers, Colonel, Corps of Engineers.

The defenses include three masonry works of old type, one of which is practically in ruins. Six platforms for 8-inch converted rifles were repaired and two platforms rebuilt, and eight 8-inch converted rifles mounted.

For the protection of the site of Fort Gaines a substantial sea wall with groins was finished during the fiscal year and a similar wall commenced at Fort Morgan and carried as far as the funds available permitted.

The battery of four 8 inch guns on disappearing carriages under construction at the beginning of the year was substantially completed, and the guns mounted. A portion of the sand fill and some minor items remain to be completed.

A concrete cable tank for the storage of torpedo cable was built during the year.

Under the act of May 7, 1898, the construction of a mortar battery for eight 12-inch mortars was authorized, and the plans are now in preparation.

Under allotments from the appropriation for "National Defense," emplacements were authorized for two 12-inch guns on disappearing carriages, for two 4.7-inch rapid-fire guns, and for two 8-inch B. L. rifles on 15-inch smoothbore carriages. At the close of the year the rapid-fire guns had been mounted, the 12-inch platforms were ready for their armament, and the construction of the 8-inch emplacements was in progress.

The entrance to the harbor was obstructed with submarine mines, planted at the outbreak of the war with Spain. The mine fields were kept in repair and patrolled to the end of the year.

(See Appendix 4 P.)

Defenses of New Orleans, La., and Sabine Pass, Tex.—Officer in charge, Maj. James B. Quinn, Corps of Engineers; assistants, Lieut. Frederick W. Altstaetter, Corps of Engineers, from December 6, 1897, and Capt. Henry Jervey, Corps of Engineers, from April 15, 1898; Division Engineer, Col. Henry M. Robert, Corps of Engineers.

The defenses of New Orleans include two masonry works of old type, which received such minor repairs as were necessary for their preservation. At the outbreak of the war one 8-inch converted rifle and seven 15-inch smoothbore guns were mounted on platforms repaired and put in order for this purpose.

At the close of the previous fiscal year the battery of two 10-inch guns on disappearing carriages had been substantially completed. During the year the remaining details were finished, an electric-light plant provided, and the guns mounted. Work was continued throughout the year upon the battery for two 8-inch guns on disappearing carriages, with the result that the battery was practically completed and the guns mounted. Some of the earth filling and certain minor details remain to be completed.

Under allotments from the appropriation for "National Defense," emplacements were authorized for two additional 8-inch guns on disappearing carriages, for two 8-inch B. L. rifles on 15-inch smoothbore carriages, and for two 4.7-inch rapid-fire guns. Active operations were in progress upon all these emplacements at the close of the year, with the expectation that they would be finished before January 1, 1899.

Submarine mines were planted in the Mississippi River and kept in condition for service to the end of the year. Owing to the great depth and swift current this work was particularly trying and difficult.

At the outbreak of the war Sabine Pass was entirely undefended, and became an object of solicitude lest its recently improved harbor be made the subject of a Spanish attack. Under the appropriation for "National Defense," temporary batteries for four siege guns were quickly constructed and the guns placed in position. These were subsequently withdrawn for use in Cuba and replaced by field guns. Provision was also made for mounting an 8-inch B. L. rifle on modified 15-inch smoothbore carriage, the emplacement for which was under construction at the close of the fiscal year.

Material for an improvised mine defense was accumulated, but the progress of events rendered planting mines unnecessary.

(See Appendix 4 Q.)

Defenses of Galveston, Tex.—Officers in charge, Lieut. Col. Alexander M. Miller, Corps of Engineers, until September 10, 1897; Capt. Charles S. Riché, Corps of Engineers, from September 10, 1897, to June 16, 1898; and Maj. James B. Quinn, Corps of Engineers, from June 16, 1898; assistants, Capt. Charles S. Riché, Corps of Engineers, until September 10, 1897, and Lieut. Harry Burgess, Corps of Engineers, since April 11, 1898; Division Engineer, Col. Henry M. Robert, Corps of Engineers.

At the beginning of the fiscal year emplacements were under construction, by hired labor, for two 10-inch guns on disappearing carriages, and by contract, under the act of June 6, 1896, for eight 12-inch mortars. During the year the gun battery was finished, except an electric-lighting system, and one gun mounted. The other gun can not be mounted until the delivery of its carriage, which is an all-round-fire disappearing one. The mortar battery was substantially completed by the contractor, and the armament mounted.

Title to an additional site of about 125 acres was acquired by purchase.

Under allotments from the appropriation for "National Defense," emplacements were authorized for two 10-inch guns and for two 8-inch guns, all on disappearing carriages, and for two 4.7-inch rapid-fire guns. At the close of the year the platforms for the 10-inch and 8-inch guns were ready for their armament, and the rapid-fire emplacements were under construction.

The entrance to Galveston Harbor was obstructed by submarine mines at the beginning of the war. These were kept in repair and the mine fields patrolled to the end of the year.

(See Appendix 4 R.)

Defenses of lake ports in New York.—Officers in charge of defenses on Lake Champlain, Maj. William S. Stanton, Corps of Engineers, until October 1, 1897, and Lieut. Col. Alexander M. Miller, Corps of Engineers, since October 1, 1897. Officer in charge of defenses of other lake ports in New York, Maj. William S. Stanton, Corps of Engineers; Division Engineer, Brig. Gen. George L. Gillespie, U. S. Volunteers, Colonel, Corps of Engineers.

These consist of three works of older type, one garrisoned and the others in the charge of ordnance sergeants. The work of shore protection at Fort Niagara, commenced in the previous year, was continued, under contract, and completed. Aside from this, no work was done at any of the forts, except such minor repairs as became necessary from time to time.

(See Appendix 4 S.)

Defenses of San Diego, Cal.—Officer in charge, Maj. Charles E. L. B. Davis, Corps of Engineers; assistants, Lieut. Herbert Deakyne, Corps of Engineers, to January 10, 1898, and Capt. James J. Meyler, Corps of Engineers, since July 3, 1897; Division Engineer, Col. Charles R. Suter, Corps of Engineers.

During the fiscal year ending June 30, 1898, two contracts were in force, one for the construction of two emplacements for 10-inch guns on disappearing carriages and a mining casemate, to be completed by December 31, 1897, and one for the construction of a third emplacement for the same battery, the time of completion being January 1, 1898. Both contracts were with the California Construction Company, of San Francisco, Cal. The time of completion was extended on both contracts until February 7, 1898, on which date the work was completed.

After the completion of the contracts many minor additions were made to the emplacements and the mining casemate, rendered imperative to put the place in readiness for actual hostilities.

Between April 19 and May 21, 1898, the guns and carriages for the three emplacements were mounted by the artillery garrison of San Diego Barracks.

Six mines were planted on May 23 and nine more on May 24, making five triple groups, leaving an open passage marked by regular channel buoys belonging to the United States Light-House Establishment.

The battery commander has two Napoleon guns trained on the mine fields, and the U. S. revenue cutter *Corwin* has charge of the patrol of that portion of the coast.

(See Appendix 4 T.)

Defenses of San Francisco, Cal.—Officer in charge of artillery defense of south side of San Francisco Bay, Col. Charles R. Suter, Corps of Engineers. Officers in charge of artillery defense of north side of San Francisco Bay, Maj. Charles E. L. B. Davis, Corps of Engineers, until January 17, 1898, and Col. Charles R. Suter, Corps of Engineers, since January 17, 1898; Division Engineer, Col. Charles R. Suter, Corps of Engineers, until January 17, 1898. Officers in charge of the torpedo defense of San Francisco and of the artillery defense of the islands in San Francisco Bay, Maj. Charles E. L. B. Davis, Corps of Engineers, until January 14, 1898, and Maj. William H. Heuer, Corps of Engineers, since January 14, 1898; Division Engineer, Col. Charles R. Suter, Corps of Engineers. On April 7, 1898, Major Heuer transferred the works of artillery defense of Angel Island to Colonel Suter, who retained charge to the end of the year. Assistants, Capt. Charles L. Potter, Corps of Engineers, until November 27, 1897; Lieut. Herbert Deakyne, Corps of Engineers, since January 10, 1898; Lieut. Louis C. Wolf, Corps of Engineers, since September 30, 1897; Lieut. Meriwether L. Walker, Corps of Engineers, from May 4 to May 14, 1898, and Capt. Francis R. Shunk, Corps of Engineers, from May 5, 1898.

The defenses include two masonry works, and a number of earthen barbette batteries of old type located at various points in the harbor. Platforms were built for seven 8-inch converted rifles, and seven additional platforms of the same kind ordered, upon which work was in progress at the close of the fiscal year.

At the close of the previous fiscal year the modern defenses consisted of a sixteen 12-inch mortar battery, completed and armed; of nine completed emplacements for 12-inch guns, five of which had their armament in position, and of three completed 10-inch emplacements, two of

which were armed. During the year three additional 12-inch guns and one 10-inch gun were mounted on completed emplacements; the construction of two additional emplacements for 10-inch guns on disappearing carriages commenced, and the same completed and armed; a second sixteen 12-inch mortar battery completed and all carriages mounted, and two 5-inch rapid-fire emplacements completed as far as practicable before the receipt of their armament. Improvements and additions required by the adopted system of fire control, and provided for in the original plans, were made to the earlier gun and mortar emplacements.

An additional mining casemate was finished, and the cable tanks at the torpedo station completed.

Under the act of May 7, 1898, emplacements have been authorized for four 12-inch guns on disappearing carriages and for two 8-inch guns on disappearing carriages. The plans for these were being prepared at the end of the year.

Under allotments from the appropriation for "National Defense," three emplacements for 8-inch guns on nondisappearing carriages were ordered, and substantially completed by the end of the year.

At the outbreak of the war active preparations were made for a torpedo defense. This was somewhat delayed by the inability to procure the needed cable, but a number of mines were successfully planted before the end of the year.

(See Appendix 4 U.)

Defenses of mouth of Columbia River.—Officer in charge, Maj. Walter L. Fisk, Corps of Engineers; assistants, Maj. Clement A. F. Flagler, U. S. Volunteers, Captain, Corps of Engineers, until December 11, 1897, and Lieut. William D. Connor, Corps of Engineers, from September 30, 1897, to April 11, 1898; Division Engineer, Col. Charles R. Suter, Corps of Engineers.

The defenses include two works of old type, both of which were garrisoned at the end of the year. A platform for 15-inch smoothbore gun was constructed and the gun mounted. Sundry minor repairs were made for the preservation of these works.

The work of mounting the armament of the four 10-inch emplacements, which was in progress at the close of the previous fiscal year, was finished, and the battery transferred to the troops for use and care. Work was continued upon the two emplacements for 8-inch guns on disappearing carriages, and the same completed and their armament placed in position. With funds derived from the act of March 3, 1897, emplacements were authorized for an additional 8-inch gun on disappearing carriage and for eight 12-inch mortars. At the close of the year the 8-inch emplacement was completed and awaiting its armament. The mortar battery was also essentially finished, and seven carriages mounted. The remainder of the armament had not yet been delivered.

Under the act of May 7, 1898, two emplacements for 10-inch guns on all-round fire disappearing carriages will be constructed, and plans are now in preparation.

Two mining casemates and a concrete cable tank for the storage of torpedo cables were built during the year.

Under allotments from the appropriation for "National Defense," preparations were made for a submarine-mine defense. Materials were accumulated, apparatus installed, explosives procured, and cables laid, but no mines had been planted at the close of the year.

(See Appendix 4 V.)

Defenses of Puget Sound.—Officer in charge, Capt. Harry Taylor, Corps of Engineers; assistant, Lieut. Meriwether L. Walker, Corps of Engineers, until May 4, 1898, and from May 14, 1898; Division Engineer, Col. Charles R. Suter, Corps of Engineers.

There are no existing works of defense on Puget Sound. During the year emplacements for four 10-inch guns on disappearing carriages, for four 10-inch guns on nondisappearing carriages, for two 12-inch guns on nondisappearing carriages, and for sixteen 12-inch mortars have been under construction. These emplacements are all being built by contract.

The platforms for all the 10-inch guns were finished at the end of the year. Two of the emplacements for 10-inch guns on nondisappearing carriages and two for 10-inch guns on disappearing carriages were practically completed at the end of the year. The other two emplacements for disappearing guns were well advanced. The remaining 10-inch emplacements were about half completed and the two 12-inch emplacements well started. The site of the mortar battery had been cleared and the excavation for one of the pits nearly completed.

A reconnaissance at Port Angeles, Wash., was made.

One site was obtained during the year, partly by purchase and partly by condemnation, and condemnation proceedings for obtaining title to two more sites begun.

Plans for a battery, consisting of five 10-inch guns and two 12-inch guns, to be located on the site acquired during the year, were prepared. (See Appendix 4 W.)

ESTIMATES OF APPROPRIATIONS REQUIRED FOR 1899-1900.

Fortifications.

For gun and mortar batteries	$4,410,000
For purchase of land for fortifications	300,000
For protection, preservation, and repair of fortifications	100,000
For preparation of plans for fortifications	5,000
For sea walls and embankments	2,500
For torpedoes for harbor defense: For the purchase of submarine mines and necessary appliances to operate them, for closing the channels leading to our principal seaports; for needful casemates, cable galleries, etc., to render it possible to operate submarine mines, and for continuing torpedo experiments	100,000
Total	4,917,500

Engineer Depot at Willets Point, N. Y.

For incidental expenses of depot	$5,000
For purchase of materials for use of United States Engineer School and for instruction of battalion	1,500
For purchase and repair of instruments	3,000
For purchase and binding of professional works for library of United States Engineer School	500
Total	10,000

RIVER AND HARBOR IMPROVEMENTS.

The funds with which the works for the improvement of rivers and harbors were prosecuted during the last fiscal year were derived from the appropriations made by joint resolution of Congress approved March 31, 1897, the sundry civil act approved June 4, 1897, and the deficiency act approved July 19, 1897, for certain works, the completion of which had been authorized by laws of September 19, 1890, July 13,

1892, and June 3, 1896, and from such balances of former appropriations as were available. The balances—mainly from the last river and harbor act (June 3, 1896)—were in most cases so small as to materially limit work, or entirely prohibit it, on the class of improvements dependent upon the usual appropriations in the river and harbor acts. In addition $250,000 was appropriated by act of February 26, 1897, for work of closing crevasse in Pass a Loutre at the mouth of the Mississippi River, operations under which were continued during the past year.

Statements derived from the reports of the officers in charge of the several works, and given herewith, set forth the condition of each improvement, and the extent of the work performed during the last fiscal year. Further appropriations for works of river and harbor improvements were made by joint resolution approved April 11, 1898, providing $2,000 for survey of Anacostia River, the sundry civil act approved July 1, 1898, providing $14,492,459.56, and the deficiency act approved July 7, 1898, providing $360,001.02.

Experience has shown that the system of providing funds for carrying on continuously or the completion of certain works has heretofore resulted in materially reducing cost and in granting benefits to commerce within reasonable periods, and if this system is restricted to works fully justified by the interests of commerce involved it will prove an economical one, provided appropriations are so made as to avoid delays in payment to contractors. The act of 1896, in providing for the completion of certain works, extends the payments for such work over several years, with the thought, possibly, that contractors would be willing to carry such works to completion rapidly, awaiting action of Congress for payment, but such result can not be assured, and in most cases, while the continuing contracts result, as a rule, in greatly reduced prices, the time of completion remains a function of the rate of appropriation of funds. The disadvantage which may result from such continuous contracts is the necessity for planning in all detail in a very limited time the work of many years in advance, which may interfere with such modifications of plan as continued experience may dictate to be most desirable.

The total amount actually expended for the improvement of rivers and harbors during the fiscal year ending June 30, 1898, is as follows:

For general improvement of rivers and harbors	$13,395,428.84
For removal of wrecks	51,334.19
For operating dredge boats and snag boats	66,432.36
For operating canals and other works of navigation	671,368.04
For work under Mississippi River Commission	2,536,786.09
For work under Missouri River Commission, including improvement of Osage and Gasconade rivers, Missouri	424,741.60
For gauging waters of the Lower Mississippi River and its principal tributaries	5,998.39
For examinations and surveys of South Pass, Mississippi River	* 9,709.57
Total	17,161,799.08

The total estimate submitted by the Chief of Engineers for 1900 for continuous work authorized by Congress is $12,883,437.

For the construction and maintenance of works authorized by Congress, but not provided for by continuing contracts, estimates amounting to $15,580,341 are presented.

Under the provisions of law the operating, care, and maintenance of

* This amount is exclusive of the sum paid the executors of the estate of James B. Eads for "maintaining jetties and other works at South Pass, Mississippi River."

certain public works is provided for by an indefinite appropriation of July 5, 1884.

A large number of the works which have been constructed by the authority of Congress, and which can not be maintained under the indefinite appropriation, require annual expenditures for repairs and renewals if they are to be kept in a state of efficiency. It has heretofore been customary to restrict estimates for improvement or maintenance to works for which a balance of the estimated cost of completion remains to be appropriated, or for which estimates for maintenance have been expressly authorized by Congress. It has been assumed, in presenting the estimates for the year 1900, that Congress, in authorizing certain work to be completed in the interest of commerce and navigation, included in such authority permission to submit estimates for preserving the improvement in an efficient condition. As a confirmation of the view taken, and to remove all doubt as to the propriety of such estimates in the future, it is recommended that general authority be granted the Chief of Engineers to present such estimates for works whose maintenance is considered necessary in the interest of commerce and navigation.

Section 6 of the river and harbor act of August 11, 1888, provides funds for gauging the waters of the Mississippi River and its principal tributaries by an indefinite appropriation of $6,000 annually.

The sum of $25,000 annually is made available by the act of August 11, 1888, for operating snag boats and dredge boats on Upper Mississippi River. The same act also makes available the sum of $100,000 annually for the work of removing snags and wrecks from the Mississippi River.

By act of September 19, 1890, as amended by act of June 3, 1896, $50,000 is made available annually for operating snag boats on Ohio River.

Reports are appended of work accomplished in the removal of wrecks obstructing or endangering navigation, as provided for in section 4 of the river and harbor act approved June 14, 1880, and enlarged by provision in the river and harbor act of August 2, 1882.

Under the authority given to the Secretary of War in section 12 of the river and harbor act approved September 19, 1890, harbor lines have been established during the past fiscal year at the following localities, details of which will be found in the local officers' reports: East side of East River, at Long Island City, N. Y., from canal of the Devoe Manufacturing Company to Newtown Creek; on the Brooklyn side of East River, New York, between Hamilton avenue and the New York and Brooklyn Bridge; eastern shore of Hudson River in front of Yonkers, N. Y.; Galveston Harbor, Texas; Davenport Harbor, Iowa; St. Clair River at Port Huron, Mich.; Sandusky Harbor, Ohio.

The provisional harbor lines established by the Secretary of War January 19, 1893, in the vicinity of the Savannah, Ga., quarantine station, were abandoned, and all orders of the War Department concerning them revoked January 6, 1898. The harbor lines along Hutchinsons Island, Savannah Harbor, Georgia, established by the Secretary of War January 19, 1893, were modified December 2, 1897.

Harbor lines for St. Joseph Harbor, Michigan, were approved by the Secretary of War April 1, 1896, and provided for a "slip" behind the Government wing dam. A modification of these lines was approved by the Secretary November 17, 1897, by which the position of the "slip" was changed to near the railroad bridge.

Examinations were made during the year, whenever required by the committees of Congress, of bills authorizing the construction of bridges and for other purposes upon which the views of the War Department were desired.

During the fiscal year examinations were made of such plans and locations as were submitted by parties interested of bridges proposed to be built over navigable waters subject to the approval of the Secretary of War. A brief statement is given of the action had in such cases.

Under sections 4 and 5 of the river and harbor act approved September 19, 1890, persons, corporations, or associations owning or controlling bridges over navigable waterways of the United States which are unreasonable obstructions to the free navigation of such waters, after being given a reasonable opportunity to be heard, have been notified to so alter the bridges as to render navigation through or under them reasonably free, easy, and unobstructed. In each case the changes required to be made were specified in the notice, and reasonable time was prescribed in which to make them. A detailed statement of the cases is given further on in this report.

I have no report to submit of instances during the year in which piers, breakwaters, or other works, built by the United States in aid of commerce or navigation, were used, occupied, or injured by corporations or individuals, reports of which are called for by section 2 of the river and harbor act approved July 5, 1884, and by section 4 of the river and harbor act approved August 5, 1886.

The river and harbor act of June 3, 1896, required the submission to Congress of a compilation with full details, of all preliminary examinations and surveys heretofore made, a complete list with details of all projects now being carried out, and certain details as to expenditures for rivers and harbors. A report containing the information called for was submitted under date of May 10, 1898, and printed in House Doc. No. 482, Fifty-fifth Congress, second session.

Obstruction of navigable Southern rivers by the aquatic plant known as the water hyacinth.—The sundry civil act approved June 4, 1897, made provision for the investigation of the obstruction of the navigable waters of Florida, Louisiana, and other South Atlantic and Gulf States by an aquatic plant known as the water hyacinth, and authorized such experiments as might be deemed necessary to determine some suitable and feasible plan or method of checking and removing such obstacles so far as they were a hindrance to interstate and foreign commerce.

For the purpose of considering the question demanding attention under this provision of law, a Board of Officers consisting of Lieut. Col. W. H. H. Benyaurd and Maj. James B. Quinn, Corps of Engineers, was constituted, by authority of the Secretary of War, to give the matter such consideration as is possible with the limited funds provided. The Board has instituted certain investigations and experiments, and it is hoped that its report will be ready at an early date. Delay in the submission of the report has occurred, owing to press of duties in connection with work on fortifications and mining defense.

Southwest Pass of the Mississippi River.—The Board of Engineer Officers appointed under the provisions of joint resolution approved February 17, 1898, for the purpose of making a survey and report upon the practicability of securing a navigable channel of adequate width and of 35-foot depth at mean low water of the Gulf of Mexico through-

out the Southwest Pass of the Mississippi River, is now engaged in the performance of the duty imposed, and it is expected that their report on this subject will be completed in time to permit of its submission to Congress before the close of its next session.

South Pass of the Mississippi River.—During the year the required channel was maintained through the shoal at the head of South Pass and through the Pass itself, except during sixty-three days, when the channel in Grand Bayou and Goat Island reaches and near the foot of Goat Island did not contain the required depth.

The required channel "through the jetties" and beyond them to deeper water in the Gulf was maintained during the year, except for four days.

The engineering works in the charge of this office are arranged in five divisions, and officers assigned as division engineers to overlook the works as follows:

West of the Rocky Mountains: Pacific Division, Col. Chas. R. Suter, Corps of Engineers. East of the Rocky Mountains: Northeast Division, Brig. Gen. G. L. Gillespie, U. S. Volunteers, colonel, Corps of Engineers; Southeast Division, Brig. Gen. Peter C. Hains, U. S. Volunteers, colonel, Corps of Engineers; Southwest Division, Col. Henry M. Robert, Corps of Engineers; Northwest Division, Col. J. W. Barlow, Corps of Engineers.

Some action, it seems to me, is necessary on the part of Congress to place it within the power of the Secretary of War to authorize expenditures of a reasonable amount in extending aid to persons injured while in the employ of the United States, and I earnestly recommend that the subject receive careful consideration and such favorable action as in the judgment of Congress may be deemed equitable.

ATLANTIC COAST AND GULF OF MEXICO.

IMPROVEMENT OF RIVERS AND HARBORS IN MAINE AND NEW HAMPSHIRE.

This district was in the charge of Maj. R. L. Hoxie, Corps of Engineers, having under his immediate orders Lieut. George P. Howell, Corps of Engineers. Division Engineer, Brig. Gen. G. L. Gillespie, U. S. Volunteers, colonel, Corps of Engineers.

1. Lubec Channel, Maine.—This channel lies between the eastern extremity of the State of Maine and Campobello Island, Dominion of Canada.

Originally the channel was but 5 feet in depth at mean low tide, and but 2 feet at low water of spring tides. A project was adopted in 1879 which, as subsequently modified, provided for a channel 275 feet wide, increasing to 300 feet in the bends, and 12 feet deep at mean low tide. This project was completed in 1890, practically as proposed, at a cost of $168,954.68. In 1894 a new project was adopted which provided for widening the existing channel to a least width of 500 feet, with a depth of 12 feet at mean low tide. The work covered by the new project has been estimated to cost $150,000.

The expenditures to June 30, 1897, amounted to $208,821.44 ($168,954.68 on the old project and $39,866.76 on the new). At that date the channel dredged under the project of 1879 had been widened 170 feet at the entrance and about 150 feet at the turn just above Cranberry Point.

The expenditures during the fiscal year 1898 amounted to $31,068.06, the operations consisting in dredging, under a contract with Moore &

Wright, for widening the channel. The total quantity of material removed under this contract was 56,000 cubic yards, the contract being completed October 1, 1897, since which time no work has been done. The channel has been widened about 170 feet at the entrance and about 190 feet at the turn just above Cranberry Point. The most difficult and expensive part of the work (that in the narrows) is completed. The depth is 12 feet at mean low tide.

The improvements render less difficult the passage of a way which is subject to strong currents and frequent fogs.

The commerce in this channel not being local it is impracticable to state definitely its character and quantity. The local tonnage for the calendar year 1897 is given at 53,400 tons. The keeper at Quoddy Head Light Station reports that 957 steamers and 7,054 sailing vessels of all classes passed through Lubec Channel during daylight in the calendar year 1897.

July 1, 1897, balance unexpended	$32,178.56
June 30, 1898, amount expended during fiscal year	31,068.06
July 1, 1898, balance unexpended	1,110.50
July 1, 1898, outstanding liabilities	10.00
July 1, 1898, balance available	1,100.50
Amount (estimated) required for completion of existing project	78,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	30,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix A 1.)

2. *Moosabec Bar, Maine.*—Before improvement the entrance at the eastern end of Moosabec Reach was difficult, the channel being crooked, with ledges on either hand. The direct entrance was obstructed by a bar on which the depth was less than 6 feet at mean low tide.

A project adopted in 1881 provided for a channel 14 feet deep at mean low tide and not less than 200 feet wide through the bar at the eastern entrance to the reach. October 30, 1888, this project was amended to cover the widening of the 14-foot channel to 300 feet, the removal of ledges obstructing the channel, and the construction of a small breakwater to divert cross currents. The estimated cost of the project is $114,000.

The expenditures to June 30, 1897, were $87,969.07. At that date the 300-foot channel had been completed, a breakwater had been built, and 1,940 cubic yards of ledge had been removed.

The expenditures during the fiscal year 1898 were $14,560.88, the operations consisting in the removal of ledge in the western approach to the channel, under a contract, which was in progress at the close of the fiscal year 1897. This contract was completed in August, 1897, the total quantity of ledge taken out being about 657 cubic yards. Work was at once commenced under another contract, which was completed in September, 1897, about 584 cubic yards of ledge being removed. No work has been done since. A channel has been dredged to 14 feet at mean low tide and the ledge at the western entrance is being excavated to a depth of 16 feet. The excavation of the ledge is to widen the entrance.

The commerce benefited is not local, the reach being extensively used by coastwise vessels both as a harbor of refuge and a sheltered

route. It has been estimated that 2,750 vessels passed through the reach during the calendar year 1897.

July 1, 1897, balance unexpended	$15,030.93
June 30, 1898, amount expended during fiscal year	14,560.88
July 1, 1898, balance unexpended	470.05
Amount (estimated) required for completion of existing project	11,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	11,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix A 2.)

3. Narraguagus River, Maine.—The obstruction to navigation consisted in a bar at the mouth of the river, over which there was a navigable depth of less than 6 feet at mean low tide.

The project is to dredge a channel not less than 200 feet wide, having a depth of 11 feet at mean low tide up to Long Point, and a depth of 9 feet from thence to the anchorage; estimated cost, $50,000.

The expenditures to June 30, 1897, for improvements below Millbridge amounted to $39,738.83. At that date the lower and middle parts of the channel had been dredged to the width of 200 feet, to the depth of 11 feet at mean low tide.

The expenditures during the fiscal year 1898 were $4,664.23, of which $4,570 was for liabilities outstanding at end of last fiscal year. No work was done. The expenditures consisted in payment for work under a contract completed about the close of the fiscal year 1897.

The work at this locality was dredged to the depth of 11 feet at mean low tide, but shoaling is liable to occur.

The commerce for the last five years is given as follows:

	Tons.
1893	60,875
1894	95,600
1895	54,750
1896	16,175
1897	41,500

July 1, 1897, balance unexpended	$5,261.17
June 30, 1898, amount expended during fiscal year	4,664.23
July 1, 1898, balance unexpended	596.94
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix A 3.)

4. Breakwater from Mount Desert to Porcupine Island, Bar Harbor, Maine.—The anchorage in front of the town of Bar Harbor, as well as the wharves at which steamers land, is exposed to storms and seas from southerly directions, at times rendering the anchorage insecure and the landing of passengers and freight at the wharves difficult. The original project was to construct a riprap breakwater on a direct line from Porcupine Island to Dry Ledge, and thence to within a short distance of Mount Desert Island.

December 17, 1890, the Secretary of War approved a slight change in the direction of that portion west of Dry Ledge, the alteration bringing the westerly end of the breakwater somewhat farther to the southward.

In January, 1893, by authority of the Secretary of War the project was again amended, and now provides for a breakwater on the direct

line first proposed, but somewhat shorter, terminating at a distance of about 600 feet from the low-water line on Mount Desert Island, and a further change has been suggested by which protection will be given to a larger area. The estimated cost of the present project is $420,200.

The expenditures to June 30, 1897, were $169,455.97, completing the breakwater for a distance of 666 feet west of Dry Ledge. The total projected length of that portion west of the ledge is 1,441 feet.

No work was done during the fiscal year 1898, the appropriation being practically exhausted.

The traffic at this locality is chiefly the transportation of passengers and supplies. No statement of tonnage could be obtained.

July 1, 1897, balance unexpended	$544.03
June 30, 1898, amount expended during fiscal year	34.63
July 1, 1898, balance unexpended	509.40
Amount (estimated) required for completion of existing project	250,200.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix A 4.)

5. *Harbor at Sullivan Falls, Maine.*—Sullivan River has a length of about 6 miles, and is the outlet of a large bay. About midway of its length a point of land projects to such extent as to reduce the width to about one-fourth that immediately above and below, and at this place the slope and velocity are such that the locality is termed Sullivan Falls. The bottom is ledge, the higher portions forming dangerous obstructions to navigation. Hatchers Rock, about midway of the narrow channel at the falls, had originally only about 6 inches of water over it at mean low tide.

Under a project completed in 1875, the sum of $35,000 was expended in removing three old piers, in excavating the obstructing ledges at the falls to a depth of 7 feet at mean low tide, and in placing spindles on two rocks near the mouth of the river. This work was of material benefit to navigation.

Under the act of 1890, an examination was made of Sullivan Falls, and a new project, estimated to cost $35,000, for removing Hatchers Rock and two other points of ledge to a depth of 10 feet at mean low tide was submitted. The first appropriation for work under this last project was by act of June 3, 1896.

There were no expenditures under the present project up to the close of the fiscal year ending June 30, 1897, and no work had been done.

The expenditures during the fiscal year 1898 were $4,834.11, the operations consisting in removing a portion of Hatchers Rock to a depth of 10 feet at mean low tide. The entire quantity of ledge taken out was about 415 cubic yards, removing nearly the entire area of Hatchers Rock to the specified depth.

The commerce for 1896 is given as 51,200 tons, and for 1897 50,790 tons.

July 1, 1897, balance unexpended	$5,000.00
June 30, 1898, amount expended during fiscal year	4,834.11
July 1, 1898, balance unexpended	165.89
Amount (estimated) required for completion of existing project	30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix A 5.)

6. Union River, Maine.—Originally the channel of Union River was much obstructed, and in the upper part almost closed, at low tide. Under a project, completed in 1873, the sum of $30,000 was expended in removing a large quantity of mill waste, ledge, and bowlders, giving a depth of 3 to 4 feet at mean low tide up to the head of navigation at Ellsworth.

A survey of Union River and Bay was made under the act of 1888, and a project was submitted for obtaining a channel through the bar at the mouth of the river by the construction of a jetty, and for a depth of 6 feet at mean low tide in the upper part of the river by dredging. The total cost was estimated at $225,000, about $145,000 of which was for dredging. It was found that the channel was again filling with mill waste. The first appropriation since this survey was by the act of June 3, 1896, which appropriated $15,000 for improving Union River by dredging. There were no expenditures under the present project up to the close of the fiscal year ending June 30, 1897, and no work had been done.

The expenditures during the fiscal year 1898 were $609.05, the operations consisting in dredging to the depth of 6 feet at mean low tide. By the close of the year the work had advanced to a point about 3,000 feet from the lower end of the dredged channel working upstream, but a section of about 1,000 feet, where harder material was encountered, was not down to grade.

The commerce for 1896 is given as 54,000 tons, and for 1897, 57,685 tons.

July 1, 1897, balance unexpended		$15,000.00
June 30, 1898, amount expended during fiscal year		609.05
July 1, 1898, balance unexpended		14,390.95
July 1, 1898, outstanding liabilities	$125.00	
July 1, 1898, amount covered by uncompleted contracts	13,680.00	
		13,805.00
July 1, 1898, balance available		585.95

Amount (estimated) required for completion of existing project	130,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix A 6.)

7. Bagaduce River, Maine.—This is a small stream that empties into Penobscot Bay at Castine, Me. The upper part of the river divides into two branches, one called Northern Bay and the other South Bay. Northern Bay near South Penobscot is a shoal sheet of water of about 700 acres area, the bottom of which for the greater part is bare at low tide. There was a narrow channel from Bridges Point to Bowden's wharf which had a depth of less than 2 feet and was obstructed by ledges and bowlders near Winslows Island. The South Bay is obstructed by ledges at Johnsons Narrows. A project for the improvement of the Northern Bay was adopted in 1890, which has for its object the securing of a channel 100 feet wide and 6 feet deep at mean low tide from Bridges Point to Bowden's wharf, at an estimated cost of $45,000. It is also intended to remove a small quantity of rock obstructing the channel at Johnsons Narrows, at an estimated cost of $1,875.

The expenditures to the close of the fiscal year ending June 30, 1897, amounted to $17,024.84. At that date the channel had been dredged its entire length for a width of 40 feet, but the full projected depth had not been obtained throughout. At Winslows Island, about midway of

the channel, and where it was shoalest, a depth of about 2 feet at mean low tide had been secured by the removal of bowlders.

The expenditures during the fiscal year 1898 were $4,765.34, the operations consisting in removing 446.7 tons of bowlders from the channel at Winslows Island. A depth of 2 feet at mean low tide is all that can be carried at Winslows Island, where the channel is shoalest.

The commerce for the last five years is given as follows:

	Tons.
1893	49,300
1894	67,850
1895	85,900
1896	78,050
1897	86,600

Probably a large proportion of this pertains to Castine, at the mouth of the river.

July 1, 1897, balance unexpended	$4,975.16
June 30, 1898, amount expended during fiscal year	4,765.34
July 1, 1898, balance unexpended	209.82
Amount (estimated) required for completion of existing project	24,875.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix A 7.)

8. *Penobscot River, Maine.*—The improvement of the Penobscot River was first undertaken in 1870, the project being for a channel not less than 150 feet wide, 12 feet deep at low tide, as far up as Bangor. At that time the channel was shoal and dangerous. At Bangor the depth did not exceed about 6 feet at lowest stages, and navigation was obstructed by numerous rocks and ledges. The work was continued until 1880, and included also the removal of obstructions in the harbor at Bangor and at Bucksport, the expenditures aggregating $198,000. No further work was done until 1884, when a project was adopted for widening the channel at Bangor and for certain improvements in the river below, near Crosbys Narrows, at an estimated cost of $75,000. While this work was in progress a survey was made, under the river and harbor act of 1886, from Bangor to Bucksport Narrows, and a project was submitted for securing a 22-foot depth between Bucksport and Winterport, at an estimated cost of $365,000, making the combined cost of the two projects $440,000. The act of September 19, 1890, appropriated $25,000 and provided for dredging near Stern's mill.

Another survey was ordered in the act of September 19, 1890, which was made, and the report published in the Annual Report of the Chief of Engineers for 1892 (pp. 533–540).

The existing project for the improvement of the Penobscot River may be stated as follows: To widen the channel at Bangor to 360 feet and a depth of 11 feet at extreme low tide; to widen, straighten, and deepen the channel near Crosbys Narrows and near Stern's mill to a depth of 12 feet at extreme low tide, and to secure a channel depth of 22 feet at mean low tide between Bucksport and Winterport, the estimated cost of the entire work being $440,000. This estimate includes the cost of jetties at Frankfort Flats and High Head, in order to contract the waterway should contraction be necessary. It is thought, however, that as the deposit of sawdust and mill waste into the river has in a large measure been stopped, and as the channels at these places were obstructed chiefly by this material, the contraction works may not be

necessary. The channel at Frankfort Flats was dredged in 1890 to 22 feet. Subsequently it filled up on the sides to some extent, the full depth in midchannel being maintained. A later survey showed that it had scoured out again, and that there existed a navigable channel not less than 500 feet wide and 22 feet or more in depth at low tide. As this is all the project contemplates, no further works of any kind are now proposed at Frankfort Flats.

The channel at High Head, which had deepened in 1891 from natural causes, subsequently filled up to some extent, so that it became advisable to dredge a channel the full depth and width called for by the project. This was done during the season of 1894.

An examination at both Frankfort Flats and High Head late in the season of 1896 showed that at Frankfort Flats there was a good channel not less than 300 feet wide, with a depth of not less than 22 feet at mean low tide. At High Head there was a break in the 22-foot contour for a distance of 500 feet. On the crest of this shoal the least depth was in excess of 19 feet at mean low tide.

No appropriation is asked for the improvement of the Penobscot River under the above project.

The appropriations up to the close of the fiscal year ending June 30, 1897, aggregated $348,300, and the expenditures under the various projects (including original survey) to the same date amounted to $338,266.86. The results accomplished are the widening and deepening of the channel at Bangor from a depth of 6 feet at extreme low tide to 11 feet, for a width of 360 feet; the dredging of a shoal at Stern's mill to 12 feet, and of a shoal just below Stern's mill to the same depth; the removal of rocks, ledges, and other obstructions; the dredging of the shoals near Bucksport, and a general increase in depth and width of channel from the mouth up to Bangor.

The expenditures during the fiscal year 1898 amounted to $1,017.14, and were principally for purchase of plant. The operations consisted in an examination of a wreck during November, 1897, reported as an obstruction in the river near Hampden.

No appropriation is asked for further work under the present project. A proposed extension of the project is contained in the report of a recent survey in the vicinity of Bangor (House Doc. No. 49, Fifty-fifth Congress, first session; also Annual Report, Chief of Engineers, 1897, p. 811.)

The commerce of the river for the last five years is given as follows:

	Tons.
1893	565,887
1894	750,313
1895	617,859
1896	715,911
1897	790,698

The principal items of freight are coal, ice, and lumber.

July 1, 1897, balance unexpended	$10,033.14
June 30, 1898, amount expended during fiscal year	1,017.14
July 1, 1898, balance unexpended	9,016.00

(See Appendix A 8.)

9. Rockland Harbor, Maine.—The location of Rockland Harbor is such that besides accommodating its own commerce, it affords a convenient refuge for large numbers of coasting vessels. When the project for a breakwater was adopted, the harbor was open to easterly storms, the anchorage was unsafe, and the seas often broke over the wharves.

The project as originally adopted in 1881 provided for two breakwaters, one starting from Southwest Ledge in the harbor and running in a northerly direction toward Jameson Point, a distance of 2,640 feet; the other starting from Jameson Point and extending southward about 1,900 feet. The estimated cost was $550,000. The top of each breakwater was to be only 5 feet above the level of mean low tide.

November 3, 1886, the project was amended so as to bring the top of the breakwater from Jameson Point to the level of high tide, leaving the other as originally designed. The estimated cost was thus increased to $650,000.

May 2, 1890, the Secretary of War approved a further modification of the project. Instead of building the second breakwater, on which no work had been done, from Southwest Ledge in a northerly direction, it was decided to prolong the one from Jameson Point in a southerly direction. By doing so a much larger area of the harbor would secure protection. The estimated cost of the new project was $632,500, this being inclusive of the part already constructed.

Under the act of 1894 a survey was made of the harbor, with a view to making it available for vessels of a deeper draft. A report on this survey, submitted in December, 1895, contained a plan for further improvement by removing two dangerous groups of ledges occupying central positions in the harbor, and for dredging along the harbor line to depths of from 4 to 13 feet at mean low tide. The estimated cost of this improvement was $402,000. Congress, by act of June 3, 1896, included this plan in the project for improving Rockland Harbor, making the estimated cost of the combined project $1,034,500. The same act authorized the removal of an old hulk, at a cost not to exceed $1,500, and provided the means. This addition brought the total cost of the improvement up to $1,036,000, of which $275,500 had been appropriated. The act of 1896 also authorized contracts to be made for the work necessary to complete the projects. The item in the act is as follows:

Improving harbor at Rockland, Maine: Continuing improvement, including project recommended by Chief of Engineers under date of December fourteenth, eighteen hundred and ninety-five, twenty-five thousand five hundred dollars, of which one thousand five hundred dollars may be expended for the removal of an old hulk sunk in the harbor: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary for the completion of said projects for the improvement of said harbor, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate seven hundred and sixty thousand five hundred dollars, exclusive of the amount herein and heretofore appropriated.

Up to the close of the fiscal year ending June 30, 1897, there had been expended on the breakwater the sum of $250,500.48, and 285,403 tons of stone had been placed in position, completing the work from the shore end out to a point 2,736 feet from high-water line.

The expenditures during the fiscal year 1898 were $30,565.35, the operations consisting in the extension of the breakwater, under a contract which was in progress at the end of the fiscal year 1897. At the close of the fiscal year 1898 the contractor had deposited 73,950 tons of stone, and the completed section of the breakwater had been extended out to a point 2,990 feet from the shore.

A contract has been made for doing all the dredging covered by the project, the price being 14 cents per cubic yard, place measurement. The work will be commenced early in the fiscal year 1899. A contract has also been awarded for doing all the ledge work covered by the project, the prices being $6.75 per cubic yard for about 11,000 yards and $6.25 per cubic yard for about 19,000 cubic yards. This work also will be commenced early in the next fiscal year. These two contracts,

together with that for completion of the breakwater, cover all the work remaining to be done for completion of the existing project for improving Rockland Harbor.

Sufficient funds are now available for expenditure in the fiscal year ending June 30, 1900, and for this reason no appropriation is asked for that fiscal year. It is not probable that such appropriation would be needed, even if work had to be readvertised and let at higher rates; but if such should be the case, a report of the fact will be promptly submitted.

The commerce of Rockland Harbor for the last five years is given as follows:

	Tons.
1893	538,506
1894	509,853
1895	615,830
1896	580,295
1897	594,992

July 1, 1897, balance unexpended		$374,999.52
Amount appropriated by sundry civil act approved July 1, 1898		300,000.00
		674,999.52
June 30, 1898, amount expended during fiscal year		30,565.35
July 1, 1898, balance unexpended		644,434.17
July 1, 1898, outstanding liabilities	$2,907.06	
July 1, 1898, amount covered by uncompleted contracts	181,479.35	
		184,386.41
July 1, 1898, balance available		460,047.76

(See Appendix A 9.)

10. Carvers Harbor, Vinalhaven, Me.—The anchorage at this harbor is limited and the harbor shoal, there being less than 8 feet at mean low tide over the most of it, which is not sufficient for the class of vessels freighting at that place.

A survey was made under the provisions of the act of 1894, and a report was submitted in February, 1895, containing two plans of improvement. The first was to dredge the inner harbor to a depth of 10 feet at mean low tide, and to make a larger area available for anchorage by the construction of a breakwater in the outer harbor, at a total estimated cost of $69,500. The second plan, estimated to cost $64,000, was to dredge the inner harbor to a depth of 16 feet at mean low tide. The latter constitutes the present project.

There were no expenditures up to the close of the fiscal year ending June 30, 1897, and no work had been done.

The expenditures during the fiscal year 1898 were $9,670.95, and operations consisted in removing 60,000 cubic yards of material, giving a depth of 16 feet at mean low tide over an area 680 feet wide, and of an average length of about 600 feet at the lower end of the inner harbor.

The commerce for 1896 was given as 63,078 tons, and for 1897 as 63,704 tons.

July 1, 1897, balance unexpended	$10,000.00
June 30, 1898, amount expended during fiscal year	9,670.95
July 1, 1898, balance unexpended	329.05
Amount (estimated) required for completion of existing project	54,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix A 10.)

11. Georges River, Maine.—This river has a depth of about 3½ fathoms up to within about a mile of Thomaston, but from there the channel is narrow, with a least depth of about 11 feet at mean low tide, with a sharp bend in the channel.

A survey was made under the act of 1894, and the report submitted in January, 1895, contained a project, estimated to cost $30,000, for deepening channel to 16 feet at mean low tide for a width of from 90 to 220 feet and for repairing a stone beacon. By act of June 3, 1896, Congress adopted this project and made the first appropriation.

There were no expenditures up to the close of the fiscal year ending June 30, 1897, and no work had been done.

The expenditures during the fiscal year 1898 were $9,728.62, and operations consisted in dredging, the total quantity of material removed being 59,994 cubic yards. The work under this contract is the first done under the existing project and has resulted in giving the full depth and width for a distance of about 2,100 feet up from the 16-foot contour. No work has been done on any other part of the stream, the conditions remaining the same as at the date of the survey.

The commerce in 1896 is given as 45,375 tons and for 1897 as 64,250 tons.

July 1, 1897, balance unexpended	$10,000.00
June 30, 1898, amount expended during fiscal year	9,728.62
July 1, 1898, balance unexpended	271.38

Amount (estimated) required for completion of existing project	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix A 11.)

12. Kennebec River, Maine.—Before the improvements were commenced the main channel of the river between the foot of Swan Island and Gardiner was obstructed by shoals near Beef Rock, with only 10 feet of water at mean low tide; by dangerous sunken ledges in Lovejoy Narrows; by a shoal below South Gardiner with only 8 feet on it at mean low tide, and by a ledge at Nehumkeg Island. The steamboat channel to the west of Swan Island (at Hatchs Rock) was obstructed by a shoal over which there was only 7½ feet of water, and the channel between Gardiner and Augusta, a distance of 6½ miles, was obstructed by shoals which gave a navigable depth of only 3½ feet of water in low summer tide.

Appropriations were made at various times between 1827 and 1852 for improving the river, and a project was adopted in 1866 for removing rocks and straightening and deepening the upper part of the river. The estimated cost was $50,000.

In 1868 the project was amended so as to give a wider channel, and the estimate was increased to $80,000. In 1871 the project was extended, the additional cost being estimated at $13,000, making the estimate for the entire project $93,000. It was again extended in 1872 to include the removal of ledges in Lovejoy Narrows at an additional estimated cost of $30,603.61. This project was modified in 1873, and as modified was completed in 1877.

In 1881 a project was adopted for the improvement of the channel west of Swan Island and near the north end of it. The estimated cost of this project, which was completed in 1883, was $20,500.

The river and harbor act of 1886 provided for a new survey of the river from Bath to Augusta. This survey was made in 1887, and a project submitted for a further improvement of the river, giving 12 feet

clear depth at low tide up to the Upper Sands Bar, near South Gardiner, 10 feet thence to Hinckley Shoal, and 8 feet thence to Augusta, together with an improvement of the steamboat channel west of Swan Island to 9 feet at mean low tide. The estimated cost of this project was $410,500, which estimate was subsequently increased to $428,500.

In August, 1892, the project was revised and a general project for the improvement adopted, as follows: For a channel depth of 13 feet up as far as Sands Island; 12 feet thence to Hinckley Shoal and 10 feet thence to Augusta; a steamboat channel 9 feet deep west of Swan Island, and the removal of old bridge piers at Hallowell, all the above depths being referred to mean low tide. The estimated cost of this revised project, which was approved August 19, 1892, was $388,500.

The total expenditures for the river up to June 30, 1897, amounted to $448,105.43. The following work had been accomplished:

The channel near Beef Rock had been improved to give a clear depth of over 12 feet, and a training wall completed. The dangerous rocks in Lovejoy Narrows had been removed to a depth of 15 feet and the channel straightened. Channels had been dredged to 12 feet at mean low tide through Upper Sands Bar, Gardiner Shoal, Browns Island Shoal, and Hinckley Lower Shoal, and to 10 feet through Hinckley Upper Shoal and Britts Shoal; thence to Augusta the channel had been deepened to about 7 feet, though some shoaling had taken place. The ledge at Nehumkeg Island had been removed to 12 feet. The steamboat channel west of Swan Island had been deepened to 11 feet and the old piers of the bridge at Hallowell had been removed. A jetty about 1,500 feet long had been completed at Upper Sands Bar. In other words, all the work under the existing project had been completed except the dredging of Gages Shoal near Augusta.

The expenditures during the fiscal year 1898 were $15,448.99, the operations consisting in dredging Gages Shoal near Augusta. Work was commenced late in September, 1897, and was in progress at the close of the fiscal year, the contract, which is for dredging a channel to the depth of 10 feet, being nearly completed. This is the last work to be done under the existing project, and will complete it unless new conditions develop. No further appropriation is asked for the present.

The commerce for the last five years is given as follows:

	Tons.
1893	970,938
1894	1,207,965
1895	1,162,972
1896	(*)
1897	665,991

July 1, 1897, balance unexpended		†$52,244.57
June 30, 1898, amount expended during fiscal year		15,448.99
July 1, 1898, balance unexpended		36,795.58
July 1, 1898, outstanding liabilities	$1,921.92	
July 1, 1898, amount covered by uncompleted contracts	7,851.60	
		9,773.52
July 1, 1898, balance available		27,022.06

(See Appendix A 12.)

13. Sasanoa River, Maine.—Originally this stream was much obstructed in the vicinity of Upper Hell Gate. The channel at and near

* No statement could be obtained.

† Differs from last year's report by $2.02, being amount of Treasury settlement for telegrams, made in December, 1896.

that place was crooked and narrow and obstructed by dangerous ledges, the shoalest of which had not more than 3 feet of water on it at mean low tide.

Between 1870 and 1871 the sum of $45,500 was appropriated, and the navigation was much improved by rock excavation, dredging, and the construction of a small jetty.

A survey was made under the act of 1894, and the report, submitted in December of that year, contained a new project, estimated to cost $19,000, for widening the channel at Upper Hell Gate to a width of 125 feet, with a depth of 12 feet at mean low tide, by ledge excavation; for dredging to the same depth at Carletons ledges, and for constructing a beacon on the jetty at Camp Ground. Congress adopted the project by the act of June 3, 1896, and made an appropriation of $19,000 for its execution.

The total expenditures for this locality up to the close of the fiscal year ending June 30, 1897, were $45,939.07. Under a former project navigation had been much improved by rock excavation and dredging and the construction of a small jetty. Under the existing project 113 cubic yards of ledge had been removed in the widening of the channel at Upper Hell Gate to the depth of 12 feet at mean low tide.

The expenditures during the fiscal year 1898 were $11,548.62, the operations consisting in completing the removal of the ledge at Upper Hell Gate so as to give a width of about 125 feet and a depth of 12 feet at mean low tide, in dredging a small shoal at Carletons ledges to the same depth, and erecting a beacon on the jetty at Camp Ground. About 796 cubic yards of ledge was removed and 955 cubic yards of material was dredged from the small shoal. The work done has been of material aid to navigation passing through Upper Hell Gate by reducing the strength of the currents as well as affording a more roomy passage.

The project is completed.

It has been impracticable to obtain complete commercial statistics, but the Eastern Steamboat Company carried during the calendar year 1897 about 45,000 passengers and 1,500 tons of freight.

July 1, 1897, balance unexpended	$18,560.93
June 30, 1898, amount expended during fiscal year	11,548.62
July 1, 1898, balance unexpended	7,012.31

(See Appendix A 13.)

14. Portland Harbor, Maine.—The entrance to the main part of the harbor of Portland, or the anchorage, has always been good, but prior to the improvements made by the Government the approach to the inner harbor was obstructed by a shoal known as the middle ground, over which the depth was only from 8 to 10 feet at mean low tide, while between it and Stamford Ledge the greatest available depth was only 16 feet. Besides, the best part of the wharf front of the city was exposed to the swell from the Atlantic, which sometimes made it dangerous for vessels to lie at the docks, and the depth along this front was in some places as little as 4 feet, making a part of it unavailable for commercial purposes.

The first work of improvement undertaken by the Government was the construction of the breakwater. This was begun as early as 1836. It was completed in 1874.

The project for the improvement of the harbor by deepening its waters was first undertaken by authority of act of Congress of 1868. The project at that time was to excavate a channel 300 feet wide through

the southern slope of the middle ground to a depth of 20 feet at mean low tide and the removal of the bar off the Grand Trunk wharves to the same depth.

In 1870 the project was amended so as to provide for a channel 400 feet wide, and in 1871 it was again amended so as to provide for a width of 500 feet.

In 1872 the improvement of Back Cove was added to the project, and in December of that year the project was further amended by providing for the dredging of the inner harbor up to the harbor commissioners' lines to a depth of 16 feet. By 1876 all the contemplated improvements had been executed except some dredging in the inner harbor.

In 1881 Congress made an appropriation for the further improvement of the harbor, and a project was adopted looking to the entire removal of the shoal known as the middle ground, at an estimated cost of $160,000. The project was completed in 1885.

In 1886 the Board of Trade of Portland asked for the further improvement of the harbor to a depth of 29 feet at low tide, and in 1886 this project was adopted, the estimated cost being $135,000. Under approval of the Secretary of War, dated February 20, 1890, this project was extended to include a small quantity of dredging in the upper harbor, estimated to cost $5,000, making the total estimated cost of the project $140,000. In February, 1894, it was again extended to cover the widening of the upper end of the 29-foot channel and the dredging of a 25-foot channel to connect the deep water in the lower part of the harbor with that in the upper part, but without addition to the estimated cost. In November, 1894, all the work proposed for Portland Harbor up to that time was completed.

By the act of 1896 Congress adopted a project for dredging to a depth of 30 feet at mean low tide over the greater part of the area of the harbor. This work was estimated to cost $770,000, and the same act combined with it the project for improving Back Cove, which was partly completed. The total estimated cost of the combined project was made $946,250.

The act of June 3, 1896, appropriated $20,000 for this work and authorized the making of contracts for its completion, but limited such contracts to $810,000 in addition to the amount appropriated. The language of the act is as follows:

> Improving Portland Harbor, Maine, according to the report of the Chief of Engineers dated April seventeenth, eighteen hundred and ninety-six, and continuing improvement of Back Cove, according to existing project, twenty thousand dollars: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary for the completion of such projects, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate eight hundred and ten thousand dollars, exclusive of the amount herein appropriated.

The total amount expended on Portland Harbor, including Back Cove, up to June 30, 1897, was $694,166.62. These expenditures resulted in giving, by means of the breakwater, partial protection to vessels at the lower wharves and an available depth of 29 feet at mean low tide up to said wharves. In Back Cove the channel had been dredged to the full width of 300 feet for about one-half its length and to a width of 215 feet for the remaining length.

The expenditures during the fiscal year 1898 were $56,088.05, the operations consisting in dredging under a contract for doing all the work covered by the present project. The first dredging was done July 2, 1897, and by the close of the fiscal year there had been removed

608,462 cubic yards, measured in place. By the removal of this quantity of material an area in the front harbor in front of the Grand Trunk wharves about 2,100 feet long and 700 feet wide was dredged to the depth of 30 feet at mean low tide. In Back Cove the channel was dredged to its full dimensions (12 feet deep at mean low tide) except in the upper portions where shoaling has occurred and which is now being redredged.

Sufficient funds are now available for expenditure in the fiscal year ending June 30, 1900, and for this reason no appropriation is asked for that fiscal year. It is not probable that such appropriation would be needed even if work had to be readvertised and let at higher rates; but if such should be the case, a report of the fact will be promptly submitted.

The commerce of Portland Harbor for the last five years is given as follows:

	Tons.
1893	1,432,805
1894	1,214,887
1895	1,339,064
1896	1,357,575
1897	1,326,844

July 1, 1897, balance unexpended		$368,560.43
Amount appropriated by sundry civil act approved July 1, 1898		200,000.00
		568,560.43
June 30, 1898, amount expended during fiscal year		56,088.05
July 1, 1898, balance unexpended		512,472.38
July 1, 1898, outstanding liabilities	$6,741.46	
July 1, 1898, amount covered by uncompleted contracts	467,182.29	
		473,923.75
July 1, 1898, balance available		38,548.63

(See Appendix A 14.)

15. Saco River, Maine.—The first work done on the Saco River was in 1827, when an appropriation was made for the erection of piers, placing beacons or buoys, and removing obstructions. Prior to this the depth of water on the bar was only about 2 feet at mean low tide, while much of the river was deeper. The entrance was also dangerous in rough weather, and the numerous projecting rocks and ledges in the river proper, in connection with the swift currents, made its navigation dangerous.

In 1866 a plan was proposed for the improvement of the mouth of the river, and a project was adopted in 1867. The project was for the construction of a breakwater, the removal of sunken rocks, and the rebuilding of some of the most important piers, against which vessels might drift without damage. This project was completed in 1878 at a cost of $169,275.

Nothing more was done on the Saco until 1883, when a resurvey of the breakwater was made and a new project submitted for raising and repairing it and extending it out to Sharps Ledge.

The river and harbor act of 1884 directed a survey to be made of the river. This was done in 1885 and a project submitted for the improvement of the river proper from its mouth to the head of navigation. In 1886 and 1888 appropriations were made for repairing and raising the breakwater and for improving the river. In 1890 the two projects were combined, so that the one now in process of execution is for improving

the Saco River, including the breakwater, and the construction of a jetty opposite the latter.

The total expenditures on both river and breakwater up to June 30, 1897, amounted to $331,398.45, and resulted in removing dangerous ledges; in constructing piers to prevent vessels from being swept on the rocks; in constructing a substantial breakwater on the north side of the entrance and a jetty on the south side of the entrance to contract the channel way with a view to obtaining a greater depth over the bar; also in deepening the channels in the upper portion of the river by dredging, and the construction of contraction works.

An examination at the mouth of the river, made in 1896, showed that the 6-foot channel had developed and maintained under the combined influence of the breakwater and jetty.

The expenditures during the fiscal year 1898 were $7,030.91, and operations consisted in raising the shore end of the breakwater on the north side of the mouth of the river, under contract. Work was commenced about the last of August, 1897, and was completed on the 11th of the following December. The total quantity of stone furnished was 5,200 tons, with which the breakwater was brought to full section for a distance of about 750 feet. The only other work proposed for the completion of the project will be any needed repairs of the jetty on the south side of the mouth of the river.

The commerce for the last five years is given as follows:

	Tons.
1893	59,765
1894	47,350
1895	62,129
1896	46,956
1897	42,214

July 1, 1897, balance unexpended	$10,376.55
June 30, 1898, amount expended during fiscal year	7,030.91
July 1, 1898, balance unexpended	3,345.64

Amount (estimated) required for completion of existing project	52,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix A 15.)

16. Cocheco River, New Hampshire.—Before the improvement was begun, the river from Dover to the Lower Narrows was much obstructed by bowlders, ledges, and shoals, the depth being in some places as little as 6 inches at mean low tide. The tide rises and falls about 7 feet.

A project for improvement was adopted in 1871, which provided for a channel 40 feet wide and 4 feet deep from the Lower Narrows up to Collin's wharf. The estimated cost was $45,000. Subsequently, more accurate and extended surveys having shown the practicability and importance of extending the improvements up to the head of navigation, the project was extended and the estimate increased to $85,000. This project was completed in 1879. The improvements had opened up a large commerce, employing large vessels where formerly only flatboats had been used, in consequence of which the project was still further extended by providing for a "cut-off" through Alleys Point, widening to 60 feet and deepening to 5 feet the existing channels through Trickeys and Clements Point shoals, and blasting and removing other obstructions. The extended project was completed in 1888.

In 1889 a new survey was made under the river and harbor act of 1888, and a new project was submitted for obtaining a depth of 7 feet,

increased to 7½ feet in rock, with a width of 50 feet in rock and 60 to 75 feet where the material is less expensive to remove. This project was adopted in 1890, and is estimated to cost $175,000.

The total expenditures for this work up to June 30, 1897, amounted to $225,217.69. These expenditures resulted in giving a channel through the rocky bed of the river 5 feet deep and 40 feet wide in the narrowest parts where the depth before was only 6 inches to 2 feet. Under the last project the upper end of the channel at Dover had been deepened to 7 feet at mean low tide for a length of 1,200 feet, with a width varying from 100 to 140 feet. Portions of the channel above and below Clement's wharf, of a total length of 600 feet, had also been dredged to the same depth, and the excavation of the channel through the ledge at Upper Narrows to 7½ feet at mean low tide had been completed.

The expenditures during the fiscal year 1898 were $6,800.28, the operations consisting in excavating a channel through the ledge in the Lower Narrows. At the close of the fiscal year about 535 cubic yards of ledge had been removed, and the work was still in progress.

The commerce for the last five years is given as follows:

	Tons.
1893	66,933
1894	68,415
1895	83,151
1896	59,755
1897	(*)

July 1, 1897, balance unexpended		$14,782.31
June 30, 1898, amount expended during fiscal year		6,800.28
July 1, 1898, balance unexpended		7,982.03
July 1, 1898, outstanding liabilities	$553.42	
July 1, 1898, amount covered by uncompleted contracts	5,715.75	
		6,269.17
July 1, 1898, balance available		1,712.86

Amount (estimated) required for completion of existing project	105,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix A 16.)

17. Harbor of refuge at Little Harbor, New Hampshire.—A survey was made of Little Harbor in 1882, and a plan of improvement proposed for the opening of a channel of entrance to a depth of 9 feet at low tide and a width of 100 feet, together with a basin 300 by 700 feet, which was to be protected by a rubblestone breakwater. The estimated cost was $33,000. This project was approved in 1886, and its execution entered upon. In 1887 the project was enlarged to provide for the construction of two breakwaters—one on the north, the other on the south side of the entrance to the harbor—and the dredging of an anchorage about 49 acres in extent in the protected area to a depth of 12 feet at mean low tide. The estimated cost of the enlarged project was $235,000, and the act of 1888 made an appropriation for the work on the enlarged plan.

In October, 1894, after the breakwaters had been completed and a part of the dredging accomplished, the project was amended by reducing the area of the anchorage to be dredged to about 40 acres instead of 49. At the same time the project was revised, and the cost of the entire work placed at $145,000.

*No statement could be obtained.

Before the improvement the depth in the harbor was only about 6 feet at low tide, and the anchorage was small and exposed.

The expenditures up to June 30, 1897, amounted to $109,828.40. At that date both breakwaters had been completed and the anchorage had been dredged to the width of about 415 feet—9 feet deep at mean low tide for about 115 feet and 12 feet deep for the remaining width.

The expenditures during the fiscal year 1898 were $8,596.36, and operations consisted in dredging and in repair of the breakwater at Jerrys Point. The work of dredging, which was in progress under contract at the close of the last fiscal year, was completed about the middle of the following August. The total quantity of material removed was about 51,993 cubic yards, by which the anchorage was widened about 85 feet, the depth being made 12 feet at mean low tide. The repair of the breakwater at Jerrys Point, which had been damaged by storms, was commenced under contract during December, 1897. The work is nearly completed.

There is no commerce belonging to this harbor, but the keeper of the life-saving station at that locality has reported that during the calendar year 1897 132 craft, with an average draft of 7 feet, entered the harbor, besides a large number of fishing boats.

July 1, 1897, balance unexpended		$10,171.60
June 30, 1898, amount expended during fiscal year		8,596.36
July 1, 1898, balance unexpended		1,575.24
July 1, 1898, outstanding liabilities	$100.00	
July 1, 1898, amount covered by uncompleted contracts	1,277.02	
		1,377.02
July 1, 1898, balance available		198.22

Amount (estimated) required for completion of existing project	25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	12,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix A 17.)

18. Removing sunken vessels or craft obstructing or endangering navigation.—The wreck of the schooner *L. Holway* just below Turners Point, Millbridge, Me., was removed to a small cove and destroyed.

The wreck of the schooner *Matilda* in Deer Island Thoroughfare, Maine, was in progress of removal at the end of the fiscal year.

The wreck of the schooner *Nevada* in Davis Strait, Maine, was removed during the year.

(See Appendix A 18.)

SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The surveys of the following localities, required by the river and harbor act of June 3, 1896, were made by the local engineer, Maj. R. L. Hoxie, Corps of Engineers, and reports thereon submitted:

1. Union River, Maine, for a deeper and broader channel.—Major Hoxie submitted report of survey dated October 22, 1897. He estimates that $225,000 will be required to secure a channel 100 feet wide and 6 feet deep at low tide through the bar at the mouth of the river and through the narrows below Ellsworth, increasing to 150 feet in width in front of the wharves at Ellsworth. This estimate includes the construction of a jetty and training wall (the latter to be marked with three rough stone beacons), built to the height of 6 feet above mean high water, to preserve the channel over the bar after the dredging is completed. He

states, however, that the improvement of all rivers on the coast of Maine is more or less interfered with by mill refuse thrown into them, and invites attention to the necessity for further legislation to prevent the deposit of mill waste and other refuse in these rivers.

The division engineer, Col. G. L. Gillespie, Corps of Engineers, in transmitting the report, stated that—

It appears from the report of Colonel Smith, November 30, 1888, Annual Report, Chief of Engineers, for 1890, Part I, page 458, and the report of Colonel Damrell, January 30, 1897, that the obstructions to the navigation of the channel arise chiefly from slabs and other mill refuse which are deposited, in part, in the river above the head of navigation, to which section 6 of the river and harbor act of September 19, 1890, does not apply. As these deposits in the higher reaches receive year by year accumulations from the original sources, it is evident that improvements which may be made by dredging in the navigable sections below Ellsworth will be more or less subject to deterioration so long as the General Government fails to prevent it by adequate legislation. Additional legislation is therefore necessary to maintain any channels which may be improved.

The report was transmitted to Congress and printed in House Doc. No. 124, Fifty-fifth Congress, second session. (See also Appendix A 19.)

2. *Survey of Bagaduce River, leading up to Penobscot village, Maine.*—Major Hoxie submitted report dated November 23, 1897. Penobscot village and South Penobscot constitute the town of Penobscot, situate on the Northern Bay branch of Bagaduce River, and a project for improvement of this locality by securing a channel 100 feet wide and 6 feet deep at mean low water, from Bridges Point to Bowden's wharf, South Penobscot, adopted in 1890, is now being carried out by the United States. The cost of completing this project is now estimated to be $52,187.30; and an improvement which would reach Penobscot village would necessitate a duplicate dredged channel, 2,600 feet in length, extending from deep water across intervening mud flats to the wharf, at a cost estimated by Major Hoxie to be $45,700.

In the opinion of Major Hoxie, the interests of commerce involved will not justify the proposed improvement under present conditions; the existing project provides for a suitable improvement for this locality, and any further expenditure for an additional channel to another point in the same town is not justifiable. His views were concurred in by the division engineer, Col. G. L. Gillespie, Corps of Engineers. The report was transmitted to Congress and printed in House Doc. No. 144, Fifty-fifth Congress, second session. (See also Appendix A 20.)

IMPROVEMENT OF RIVERS AND HARBORS IN EASTERN MASSACHUSETTS.

This district was in the charge of Col. S. M. Mansfield, Corps of Engineers, having under his immediate orders Maj. John Stephen Sewell, U. S. Volunteers, first lieutenant, Corps of Engineers.

1. *Newburyport Harbor, Massachusetts.*—Newburyport, Mass., is situated about 2½ miles from the Atlantic Ocean, on the south bank of the Merrimac River. The mouth of the river is obstructed by a sandy bar, over which originally but 7 feet draft at low water could be carried in a narrow, shifting channel.

The object of the improvement is to create through the outer bar a channel 1,000 feet wide and at least 17 feet deep at mean low water, so that vessels may cross the bar and find a harbor at any stage of the tide with as great draft as can reach Newburyport by the river at high tide.

The project submitted September 16, 1880, proposed two converging rubblestone jetties, their outer ends 1,000 feet apart and to be extended parallel to the axis of the channel if necessary, and the protection of the beach *in their vicinity, at a cost*, as estimated in 1881, of $365,000.

The direction of jetties and shore protection were modified in 1883, and in 1882 the partial closing of Plum Island Basin with a timber dike about 800 feet long and 5½ feet above mean low water was added to the project, increasing the cost to $375,000, as estimated in 1884.

In 1884 a modification of project provided for extension of both jetties parallel to the axis of the channel for a distance of 610 feet, and in 1886 the length of extension was increased to 1,000 feet, increasing the cost of work, as estimated in 1897, $224,547.49.

The total appropriations to date have been $313,500.

The total expenditures to June 30, 1897, were $296,956.35, and at that date the north jetty was completed for a total length of 2,705 feet and the south jetty for 1,540 feet.

The Plum Island Dike was 817 feet long, 5½ feet high above mean low water, except near the center, where a weir 150 feet long and 2 feet above mean low water was left temporarily.

The sand catch in rear of the south jetty was in two branches, one 480 feet long and one 572 feet long.

Two channels of almost equal width and 10.5 feet depth at mean low water existed across the bar, one extending to the southward along the shore of Plum Island and the other to the eastward normal to the bar.

A contract was in force for the delivery of 13,000 tons of rubble-stone in extension of the south jetty, which delivery was completed December 30, 1897, 250 feet of the parallel section of the south jetty being built.

No survey of the bar was made in 1898, but the reports of local pilots show that the extension of the south jetty has resulted in closing the southern channel along Plum Island and in deflecting the ebb currents over the bar through the eastern channel in the location proposed by the project of improvement.

July 1, 1897, balance unexpended	$16,543.65
June 30, 1898, amount expended during fiscal year	14,793.42
July 1, 1898, balance unexpended	1,750.23

Amount (estimated) required for completion of existing project	286,047.49
Amount that can be profitably expended in fiscal year ending June 30, 1900	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix B 1.)

2. *Merrimac River, Massachusetts.*—The mouth of the Merrimac River is 15 miles northwest from Cape Ann, Massachusetts. Tide water extends up it a distance of 21½ miles, or to the foot of the Upper Falls, 1½ miles above Haverhill, Mass.

Seven incorporated cities and the largest mills in New England are directly interested in this improvement.

Before improvement the channel was narrow and crooked and much obstructed by ledges, bowlders, and shoals. At mean low water vessels drawing not to exceed 7 feet could enter the river and proceed to South Amesbury, 9 miles from the mouth.

The rise or fall of the tide at the mouth is 7.7 feet; at Haverhill Bridge, 4.6 feet.

The project originally adopted in 1870, as modified in 1874, provides for a channel with the following depths at ordinary high-water stages of the river: From the mouth to Deer Island Bridge, 5 miles, 16½ feet; *thence to Haverhill* Bridge, 12½ miles, 12 feet; thence to the foot of *Mitchells Falls, Hazeltine* Rapids, 1½ miles, 10 feet; thence through

Mitchells Falls to the head of the Upper Falls, 2½ miles, not less than 4½ feet when the mill water at Lawrence is running.

This revised project was estimated to cost $147,000.

The total appropriations to date are $247,366.72.

The expenditure to June 30, 1897, was $246,060.67.

The excess of expenditure over the estimate is due to the removal of rocks and other obstructions that were unknown and removal not contemplated when the estimate was made, and by the expense of necessary surveys and examinations not provided for in the estimate.

On June 30, 1894, the project for the improvement of the river was completed.

The act of August 18, 1894, provided for a resurvey of the river, with a view of obtaining a depth up to Haverhill equal to that over the bar at Newburyport. The report on this survey is published as House Doc. No. 168, Fifty-fourth Congress, first session, and in Annual Report, Chief of Engineers for 1896, page 616.

On May 5, 1897, an estimate was submitted of cost of obtaining a channel 150 feet wide and 7 feet deep at mean low water from Newburyport to Haverhill, in accordance with the river and harbor act of June 3, 1896. This estimate was published as House Doc. No. 52, Fifty-fifth Congress, first session, and also in Annual Report, Chief of Engineers, 1897, page 865.

The river and harbor act of June 3, 1896, appropriated $5,000 for the removal of certain rocks below Rocks Bridge, and the channel has been cleared of these obstructing bowlders. The commerce involved in this improvement consists of supplies of coal, lumber, etc., for cities and towns situated on its banks to the head of navigation. No definite statement of the amount and value thereof can be given.

July 1, 1897, balance unexpended	$1,306.05
June 30, 1898, amount expended during fiscal year	1,160.00
July 1, 1898, balance unexpended	146.05

(See Appendix B 2.)

3. Powow River, Massachusetts.—Powow River is a tributary of the Merrimac River, into which it enters from the north about 3½ miles above Newburyport.

From its mouth tide water extends 9,600 feet in a narrow, crooked channel, not navigable at low water.

The project proposed for its improvement is to dredge a channel 9,600 feet long, 60 feet wide, and 12 feet deep at mean high water, estimated to cost $100,000 in 1897.

The total appropriations to date have been $39,000.

The expenditures to June 30, 1897, were $38,876.07.

At that date the improved channel was 12 feet deep at mean high water, 45 feet wide for 3,252 feet from its upper end, and at least 30 feet wide throughout its full projected length.

No operations were in progress during the fiscal year, and at the date of this report the condition of the improvement is the same as on June 30, 1897.

July 1, 1897, balance unexpended	$123.93
June 30, 1898, amount expended during fiscal year	106.25
July 1, 1898, balance unexpended	17.68
Amount (estimated) required for completion of existing project	61,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix B 3.)

4. Essex River, Massachusetts.—Essex River empties into Ipswich Bay about 3 miles southeast of the mouth of Ipswich River, Massachusetts. It is navigable at high water to the wharves in the town of Essex, a distance of 6 miles, but no navigable low-water channel exists for 12,000 feet below the town wharves.

The mean rise or fall of the tide is 8.8 feet.

The object of the improvement is to widen and deepen the natural channel of the river.

The project for improvement was submitted May 15, 1891, and proposed a channel 60 feet wide and 4 feet deep at mean low water to the wharves at Essex, estimated to cost $25,000.

The total appropriations to date have been $15,000.

The expenditures to June 30, 1897, were $9,711.39.

At that date the channel had been dredged to its full projected depth, and at least 25 feet wide to the drawbridge at Essex.

On July 13, 1897, a contract was entered into for dredging 14,000 cubic yards from the channel, in continuation of the improvement.

Operations under this contract were commenced October 14, 1897, and completed December 22, 1897, and at the date of this report the channel is 4 feet deep at mean low water, of full projected width of 60 feet for 4,000 feet below the drawbridge, and at least 25 feet wide for the remaining distance below that bridge.

July 1, 1897, balance unexpended	$5,288.61
June 30, 1898, amount expended during fiscal year	5,012.39
July 1, 1898, balance unexpended	276.22
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix B 4.)

5. Harbor of refuge, Sandy Bay, Cape Ann, Massachusetts.—Sandy Bay is situated at the northeastern extremity of Cape Ann, Massachusetts. It is about 2¾ miles by 2 miles in area, and is fully protected on the west and south by high hills, but fronts the northeast, and is open to the full effects of easterly and northeasterly gales.

The proposed improvement contemplates the construction of a national harbor of refuge of the first class. The anchorage covered by the breakwater will contain 1,377 acres.

The estimated cost of the improvement is $5,000,000. The original project of 1884 proposed to build only the substructure of the breakwater of rubblestone. The present project, approved March 17, 1892, proposes to build the entire breakwater of rubblestone, the portion below low water to be built of stone of less than 4 tons weight, the upper portion of stone averaging 6 tons weight.

The plan of the bay showing the proposed breakwater was published in the Annual Report of the Chief of Engineers for 1892, page 564.

The total appropriations to date have been $900,000.

The expenditure to June 30, 1897, was $723,485.25.

Operations were in progress during the fiscal year, under two contracts, for the deposit of small stone in the breakwater, under which 140,945 tons was delivered; 1,064,277 tons of small stone and 13,448 tons of large stone have been deposited in the breakwater to date.

No serviceable sheltered anchorage has as yet been secured by these operations.

The completed section of the breakwater was damaged by a severe storm which visited the coast about February 1, 1898.

At the date of this report 600 running feet of the breakwater is completed to about high water; 2,400 feet additional is practically completed to low water, and for a farther length of 1,600 feet the mound is at least 40 feet wide on top and up to 22 feet below low water.

The entire commerce of New England is directly interested in this improvement.

July 1, 1897, balance unexpended		$176,514.75
June 30, 1898, amount expended during fiscal year		103,822.29
July 1, 1898, balance unexpended		72,692.46
July 1, 1898, outstanding liabilities	$18,849.04	
July 1, 1898, amount covered by uncompleted contracts	40,036.32	
		58,885.36
July 1, 1898, balance available		13,807.10
Amount (estimated) required for completion of existing project		4,100,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900		250,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix B 5.)

6. *Harbor at Gloucester, Massachusetts.*—Gloucester Harbor, an important center for the fishing fleet of New England, is about 20 miles north of Boston. Its inner harbor was originally obstructed by sunken rocks and shoals, and the approaches to the wharves were shallow, varying from 1 to 12 feet. The outer harbor was open to all southerly gales.

The project of 1871 proposed the removal of certain bowlders from the inner harbor and the construction of a breakwater from Eastern Point over Dog Bar to Round Rock Shoal.

The project of 1884 provided for two breakwaters at the entrance of Gloucester Harbor, one to cost $752,000, on essentially the same site as that proposed in 1871, and a supplementary one, through Normans Woe Rock, to cost $607,000.

In the annual report for this harbor for 1887 a general project for its improvement was submitted, based on the survey provided for by the act approved August 5, 1886. This project proposed to remove from the inner harbor 101½ cubic yards of rock known to exist, and to dredge 216,000 cubic yards, scow measurement, at an estimated cost of $65,000, and to construct the breakwater recommended in the project of 1884, that extends from Eastern Point to Round Rock Shoal, at an estimated cost of $752,000. In 1897 the form of breakwater was modified and cost reduced to $733,121.18.

On May 5, 1897, a project was submitted, in accordance with the river and harbor act of June 3, 1896, for the removal of a pinnacle rock in the outer harbor to a least depth of 16 feet below mean low water, and rocks off the Ferry Landing at Rocky Neck to a level of the surrounding bottom.

The total appropriations to date are $154,000.

The expenditures to June 30, 1897, were $134,385.68.

The condition of the improvement June 30, 1897, was as follows:

Clam Rock had been reduced from 1 foot to 9⅓ feet at mean low water; Pinnacle Rock from 8½ to 16½ feet, mean low water; rock off Pew's wharf from 2 to 5 feet, mean low water; rocks off J. Friend's wharf from 13 to 17 feet, mean low water. All of the above rocks were reduced to the

level of the surrounding bottom. Babsons Ledge had been reduced from 11 to 14 feet, mean low water. All the proposed dredging had been done and the construction of the breakwater from Eastern Point to Round Rock Shoal was in progress; 74,468 tons of rubblestone had been deposited in the breakwater, and about 1,100 feet of the substructure had been completed.

The movement of the vessels in the inner harbor had been greatly facilitated, but no benefit had been derived from work on the breakwater, as no sheltered anchorage had been obtained.

During the fiscal year operations were continued under the contract of October 12, 1896, and it was satisfactorily completed April 5, 1898.

On July 6, 1897, a contract was entered into for the removal of 105 cubic yards of ledge under the project of May 5, 1897, and completed August 19, 1897.

The work in its present stage has greatly benefited the fishing industry, and its completion will furnish much-needed sheltered anchorage in this important harbor.

A line of passenger and freight steamers is operated continuously throughout the year, and other commerce exists in the form of imports of salt, coal, lumber, etc.

The estimated value of this commerce is $5,000,000 annually.

July 1, 1897, balance unexpended	$19,614.32
June 30, 1898, amount expended during fiscal year	18,783.38
July 1, 1898, balance unexpended	830.94
Amount (estimated) required for completion of existing project	624,083.43
Amount that can be profitably expended in fiscal year ending June 30, 1900	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix B 6.)

7. *Harbor at Manchester, Massachusetts.*—Manchester Harbor is situated about 5½ miles northeast from the entrance of Salem Harbor, Massachusetts.

The channel was 100 feet wide and 6½ feet deep at mean low water up to Proctors Point. It then shoaled rapidly to a depth of 1½ feet at "The Narrows," 1,400 feet from Proctors Point, and for a farther distance of 2,500 feet to the town wharves no low-water channel existed.

The original project, that of 1887, proposed to dredge a channel 60 feet wide, 4,000 feet long, and 4 feet deep at mean low water from Proctors Point to the town wharves, at an estimated cost of $14,300.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for 1888, Part I, page 466.

A survey in accordance with act of June 3, 1896, was made in August, 1896, and on April 7, 1897, a project was submitted. The estimated cost of the project is $139,966.09. The report was printed in House Doc. No. 29, Fifty-fifth Congress, first session; also in Annual Report, Chief of Engineers, 1897, page 866.

The total appropriations to date have been $14,300.

The expenditure to June 30, 1897, was $14,246.96, and the improvement was essentially completed. The channel was 60 feet wide, 4 feet deep, and 4,000 feet long; opposite the town wharf it was 80 feet wide.

On June 30, 1897, a project for a less extensive improvement than that proposed in the project of April 7, 1897, was submitted, and was estimated to cost $25,000. (Annual Report, 1897, p. 869.)

No other operations were in progress during the fiscal year.

The commerce involved in this improvement consists of supplies of

coal, lumber, etc., for local consumption. The improvement in its present condition has greatly facilitated the approach of vessels to the town wharves.

The value of the commerce involved is approximately $30,000 annually.

July 1, 1897, balance unexpended	$53.04
June 30, 1898, amount expended during fiscal year	53.04

(See Appendix B 7.)

8. *Harbor at Lynn, Massachusetts.*—Lynn Harbor is situated 9 miles northeast from Boston. It is approximately 1 by 2 miles in extent, of which the greater part is dry at low tide.

It is protected on the north and west by the mainland, on the east by Nahant Beach, and its entrance, 2 miles wide, into Massachusetts Bay is on the south side.

Before improvement three narrow and crooked channels of approach to the wharves existed, in each of which there was about 6 feet depth at mean low water. The mean rise or fall of the tide is 9.3 feet.

The western channel leads to the Point of Pines and the mouth of the Saugus River. The main ship channel is entered between White and Lobster rocks and connects about 3,600 feet northward with the Black Rock Channel, which is the most eastern, near Nahant Beach.

The original project, that of 1894, for the improvement proposed to excavate a channel 3,610 feet long, 200 feet wide, and 10 feet deep at mean low water from a point near and east of White Rocks to deep water, opposite Little Nahant, and a channel 6,450 feet long, 200 feet wide, and 10 feet deep at mean low water, from deep water, opposite Sand Point, to the harbor commissioner's line, and a training wall about 6,000 feet long, to start from the shore line at Little Nahant and to cross Black Rock Channel, its outer portion to be parallel to the outer improved channel, its purpose being to aid in keeping the outer channel open.

The cost of this project was estimated to be $145,000, increased in 1885 to $157,000.

A plan of the harbor, showing the projected improvement, was published in the Annual Report of the Chief of Engineers for 1884, Part I, page 532.

The river and harbor act of August 11, 1888, authorized the extension of the main ship channel 400 feet within the harbor line, and the excavation at its inner end of a basin 500 by 300 feet in area, 10 feet deep at mean low water, increasing total cost of improvement to $182,000.

In accordance with the provisions of the river and harbor act of June 3, 1896, a survey of this harbor was made in October, 1896, "with a view to securing a channel 300 feet wide and 15 feet deep at low water," and in 1897 a project was submitted estimating cost of work to be $441,813.07. The report of this survey is published in House Doc. No. 28, Fifty-fifth Congress, first session; also in Annual Report, 1897, page 872.

The total appropriations for this work to date have been $128,500.

The total expenditures to June 30, 1897, were $103,650.05 on the project, and $5,000 on the western or Saugus River Channel, and at that date the outer channel and basin were finished; the inner channel was completed for 4,100 feet at its southern end, and the remainder is 150 feet wide; the western or Saugus River Channel of 4,000 feet length, 150 feet wide, 8 feet deep at mean low water.

A contract for dredging 40,000 cubic yards from inner main ship channel was finished during the fiscal year, and at the date of this

report the project of improvement is completed, excepting the training wall, the necessity for which is not apparent.

The commerce involved in the improvement consists of coal, lumber, and other domestic and manufacturing supplies, and the improvement has enabled them to be brought in large vessels, thereby reducing freights and costs.

July 1, 1897, balance unexpended	$19,849.95
June 30, 1898, amount expended during fiscal year	12,444.15
July 1, 1898, balance unexpended	7,405.80

(See Appendix B 8.)

9. Mystic and Malden rivers, Massachusetts.—Mystic River empties into the inner harbor of Boston, Mass., and extends from the navy-yard to the town of Medford, a distance of about 4½ miles. Malden River is about 2 miles long from the town of Malden to its junction with Mystic River, about 3 miles above the navy-yard.

Originally Mystic River had no navigable low-water channel. A project for its improvement was submitted May 9, 1891. It proposed to widen and deepen the natural channel of the river so that it should be 100 feet wide and 6 feet deep at mean low water to the first turn above Denning's wharf, and thence to the head of navigation 4 feet deep, with the width gradually reduced to 50 feet at Craddock's bridge. The cost of this improvement was estimated to be $25,000.

Originally in Malden River there was a narrow and exceedingly crooked channel with a navigable depth of barely 7 feet at mean high water. The rise of the tide is 9.8 feet. The original project for its improvement, proposed December 1, 1880, contemplated the excavation of a channel 100 feet wide and 12 feet deep at mean high water up to the second drawbridge, with two cut-offs, one east of the island, near the junction of the Malden and Mystic rivers, and the other through the marsh land about half a mile above; estimated cost, $35,000. This project, as modified in 1882, proposed to make the natural channel 100 feet wide and 12 feet deep at mean high water to the first bridge, and thence 75 feet wide to the second bridge; estimated cost, $40,000. This estimate was increased to $47,000 in 1884. (Annual Report, 1884, p. 551.)

Ten thousand dollars, appropriated for this work by the act of 1882, was expended (1883–84) in making the channel from the mouth to the drawbridge in Malden, a distance of 1¼ miles, at least 50 feet wide (70 feet at turns) and 12 feet deep at mean high water.

On November 1, 1890, a project was submitted for the improvement of this river in conjunction with Mystic River. This project proposed the completion of the project of 1882, at an estimated cost of $37,000.

The total appropriations to date, under present approved projects, have been $30,000.

The expenditures to June 30, 1897, under the present projects were $20,117.08, and at that date the improved channel in Mystic River was 6 feet deep at mean low water and 100 feet wide to the first turn above Denning's wharf, and for a distance of 1,500 feet above this turn 4 feet deep and at least 50 feet wide; and the channel in Malden River was at least 75 feet wide and 12 feet deep at mean high water to the first bridge. The navigation of both rivers had been greatly facilitated by the improvement.

At the beginning of the fiscal year operations were in progress under a contract dated October 19, 1896, for dredging 26,000 cubic yards, more or less, of material from these rivers, at 34½ cents per cubic yard; *this work was completed* December 4, 1897.

At the date of this report the improved channel in Mystic River is completed to full projected depth and width from the mouth to 5,200 feet above Denning's wharf; and the improved channel in Malden River is completed to the full projected depth and width up to the first bridge. Nothing has been done above this bridge.

The commerce involved in this improvement is for the cities of Charlestown and Medford on the Mystic River, and the city of Malden on the Malden River.

To complete the improvement of Mystic River would require an appropriation of $10,000, and of Malden River $22,000, a total of $32,000.

July 1, 1897, balance unexpended	$9,882.92
June 30, 1898, amount expended during fiscal year	9,856.00
July 1, 1898, balance unexpended	26.92
Amount (estimated) required for completion of existing project	32,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	15,000,00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix B 9.)

10. Harbor at Boston, Mass.—Boston Harbor consists essentially of an inner and outer harbor united by a deep waterway, and each accessible from the sea by a distinct channel, widening into a deep and spacious roadstead.

(*1*) *Inner harbor.*—This harbor lies to the north and westward of Long Island, and has deep water and good anchorage in the President Roads, seaward of Lower Middle Bar, and also near the city westward of Upper Middle Bar.

Four rivers discharge their waters into the basin—the Charles, Mystic, and Chelsea rivers from the north, and the Neponset from the south. The direct entrance from the sea is by Broad Sound.

(*2*) *Outer harbor.*—This harbor lies to the southward of Long Island, and has a fine anchorage in Nantasket Roads as well as in Hingham Bay, a well-sheltered harbor southeast of Paddocks Island. It connects with the inner harbor by the main ship channel, through the Narrows, and by secondary channels east and west of Long Island. It is reached from the sea by Nantasket Roads, which lie south of Georges and Great Brewster islands, and is marked at the sea entrance by Boston Light.

Weymouth and Weir rivers empty into the outer harbor.

Both the inner and outer harbors are subdivided into several minor harbors, and contain many islands which shelter the anchorages from winds and storm waves.

The range of the tide at the navy-yard is 9.8 feet, and at the entrance to the outer harbor 9.4 feet. A sketch of the harbor was printed in the Annual Report of the Chief of Engineers for the year 1888, page 454.

The object of the improvement is, first, to preserve the harbor by protecting the islands and headlands; and, second, to improve it by widening, deepening, and straightening the channels.

The works of preservation consist of sea walls, aprons, jetties, etc., which protect the shores of the islands and headlands, prevent additional wash into the channels, control the tidal scour, and preserve the full height of anchorage shelter for vessels in the roadsteads.

The works of improvement have been by dredging and blasting.

The total appropriations from 1825 to date have been $3,274,276.10.

The total expenditure to June 30, 1897 (not including outstanding liabilities), was $2,730,065.74.

Works of preservation.—The location and details of these works are

given in the Annual Report of the Chief of Engineers for 1895, pages 621 and 622.

With the exception of the sea walls at Deer Island, they were all in fair order, and no work has been done on them during the fiscal year.

During the year repairs have been made to about 228 running feet of wall.

Works of improvement.—The works of improvement have been by dredging and blasting, by which means many dangerous rocks and shoals have been removed and the main ship channel enlarged from 100 feet wide and 18 feet deep at mean low water, so that on June 30, 1897, it was at least 625 feet wide and 23 feet deep at mean low water throughout, and the lower main ship channel to President Roads was 27 feet deep at mean low water, 1,000 feet wide from the entrance (near the outer light) to Bug Light, and in the Narrows 800 feet wide to the passage between Georges and Gallops islands, where it was at least 550 feet wide; but the free use of this 27-foot channel was restricted by reason of ledges uncovered by the dredging.

The following tributary channels have also been improved, and their condition on June 30, 1897, was as follows:

a. Charles River.—The natural channel of this river has been widened, straightened, and deepened, so that from its mouth to Western Avenue Bridge, a distance of 4¾ miles, the channel has a width of 200 feet and a depth of 7 feet at mean low water. Thence to Arsenal Street Bridge, 2½ miles, the channel has a least width of 80 feet and a least depth of 6 feet.

By the act of September 19, 1890, $20,000 was appropriated for the improvement of Charles River, provided "that the draws in the Arsenal Street and Market Street bridges shall be made to conform to the projected channel without cost to the United States." This sum still remains unexpended because the Market Street Bridge has not been remodeled.

b. Fort Point Channel.—This important branch of the main ship channel had a least depth of 12 feet at its entrance, and the channel was narrow and crooked.

The project for its improvement was submitted January 27, 1885. It proposed the excavation of a channel 175 feet wide and 23 feet deep at mean low water from the entrance to near Federal Street Bridge, a distance of 4,100 feet, and was estimated to cost $100,000; the railroad bridge to be reconstructed at the expense of the owners. It has been widened to 175 feet and deepened to 23 feet at mean low water from its mouth to Congress Street Bridge, a distance of 1,900 feet.

The project can not be completed until the railroad bridge shall have been reconstructed.

c. Nantasket Beach Channel.—This channel was originally about 50 feet wide and 8 feet deep at mean low water. It is now 150 feet wide and 12 feet deep at mean low water.

d. Channel below Nixs Mate and Long Island.—This channel had originally 4½ feet depth at mean low water. A cut has been made through the bar 300 feet wide, 15 feet deep at mean low water.

e. Broad Sound.—An obstruction called Barrel Rock was removed in 1869.

f. Jeffreys Point Channel.—This channel is an extension of the main ship channel from near Grand Junction Wharf (East Boston) toward Jeffreys Point. It is now 400 feet wide from Grand Junction Wharf to just east of Simpson's patent dry docks, and 18 feet deep at mean low water, thence gradually narrowing to 250 feet, and decreasing in depth of water to 15 feet at mean low water at a junction with the same depth off Jeffreys Point.

g. Chelsea Creek.—This tributary empties into the upper part of Boston inner harbor and lies between East Boston and the city of Chelsea. It had originally but 14 feet at mean high water in a narrow channel very difficult of navigation. The project of improvement proposed to dredge a channel 150 feet wide and 18 feet deep at mean high water to the head of navigation. At the date of this report the channel is 14 feet deep at mean high water, at least 35 feet wide, and of greatly increased width at turns.

No operations have been in progress in any of these tributary channels during the fiscal year.

Under the project of 1867 there remains to be appropriated for completion of sea walls of Point Allerton, Georges Island, and Governors Island $112,000, and for completion of improvement of subsidiary channels of Charles River, Fort Point, and Chelsea Creek $165,500, making a total of $277,500. Work remaining to be done under the project of 1867 is not included in the project of 1892 or covered by the continuing contract authorized by the act of June 3, 1896.

On June 30, 1896, operations were in progress under a contract to remove 8,772 cubic yards of ledge from the main ship channel, and during the fiscal year 2,351 cubic yards was removed, a total of 8,772 cubic yards removed under the contract.

At the date of this report the full width of the 27-foot channel has been cleared of ledges by these operations.

The act of June 3, 1896, provides as follows:

Improving harbor at Boston, Massachusetts: Continuing improvement, seventy thousand dollars: *Provided*, That this sum may, in the discretion of the Secretary of War, be used in the preservation and improvement of said harbor, including the project for improving the main ship channel, and that seven thousand dollars of this sum may, in the discretion of the Secretary of War, be used in improving Chelsea Creek, and so much thereof as the Secretary of War in his discretion shall direct to be expended for the protection of Great Head, Winthrop, to prevent the further washing away by the action of the sea: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary to carry out the revised project of August eleventh, eighteen hundred and ninety-two, such contracts to provide that said ship channel shall be widened to a minimum width of one thousand feet and a minimum depth of twenty-seven feet, to be paid for as appropriations may from time to time be made by law, in the aggregate not to exceed one million one hundred and forty-five thousand dollars, exclusive of amount herein and heretofore appropriated.

On February 11, 1897, a contract was entered into to dredge 2,910,718 cubic yards, more or less, from the main ship channel in completion of the dredging item of the project of August 11, 1892.

Operations under this contract were commenced on October 25, 1897, and during the fiscal year 479,308½ cubic yards of material was dredged from the lower main ship channel in the Narrows, resulting in widening the 27-foot channel in the Narrows from 550 feet to 640 feet.

Further contracts for ledge excavation will be made as soon as the rock is uncovered.

The upper main ship channel is, at the date of this report, in the same condition as on June 30, 1897.

PROJECT OF 1867.

July 1, 1897, balance unexpended	$99,253.71
June 30, 1898, amount expended during fiscal year	52,743.35
July 1, 1898, balance unexpended	46,510.36
Amount (estimated) required for completion of existing project	277,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

PROJECT OF 1892.

July 1, 1897, balance unexpended		$444,956.65
Amount appropriated by sundry civil act approved July 1, 1898		250,000.00
		694,956.65
June 30, 1898, amount expended during fiscal year		58,272.81
July 1, 1898, balance unexpended		636,683.84
July 1, 1898, outstanding liabilities	$32,738.08	
July 1, 1898, amount covered by uncompleted contracts	425,158.17	
		457,896.25
Amount (estimated) required for completion of existing project		163,750.78
Amount that can be profitably expended in fiscal year ending June 30, 1900		163,750.78
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix B 10.)

11. Town River, Massachusetts.—Town River is a small tidal river debouching into Weymouth Fore River, and lies within the limits of the city of Quincy. It is about 1½ miles long from its mouth at Quincy Point to the upper wharves of the city.

The upper half of the river (three-fourths of a mile) has a very narrow and crooked channel, carrying about 1½ feet of water at low tide.

The project for the improvement of this river, submitted December 31, 1890, proposed to dredge a channel 4,500 feet long, 100 feet wide, and 4 feet deep at mean low water to the head of navigation, at an estimated cost of $20,000, increased in 1897 to $25,000.

The total appropriations to date have been $10,000.

The expenditures to June 30, 1897, were $105.72.

At that date no appreciable improvement had been secured under the project, but operations were in progress under a contract dated October 15, 1896, to dredge 33,000 cubic yards of material from the river, which was completed September 4, 1897.

At the date of this report the improved channel is 4 feet deep at mean low water, 50 feet wide for a length of 3,500 feet, and 30 feet wide for a farther length of 800 feet.

The commerce involved in the improvement of this river consists of coal, lumber, etc., for the city of Quincy, and the output of the Quincy granite quarries shipped by water. The value of this commerce annually will approximate $200,000.

July 1, 1897, balance unexpended	$9,894.28
June 30, 1898, amount expended during fiscal year	9,651.71
July 1, 1898, balance unexpended	242.57
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	8,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix B 11.)

12. Weymouth River, Massachusetts.—Weymouth Fore River, tributary to Hingham Bay, Boston Harbor, Massachusetts, is one of the most important water courses on the south coast of Massachusetts Bay. It is navigable at low water for vessels not exceeding 18 feet draft for 4 miles from its mouth, and for a farther distance of 3 miles, to the head of navigation, at least 3 feet depth was found at mean low water before its improvement.

Weymouth Back River lies east of the Fore River, forming a portion of the boundary between the town of Weymouth and Hingham. Its

course is northerly, and it enters into Hingham Bay at the mouth of Weymouth Fore River.

The original project of improvement of Weymouth Fore River was submitted December 2, 1889. It proposed to improve the natural channel of the river by dredging, so that 6 feet depth at mean low water could be carried to the head of navigation, in a channel 100 feet wide to near the wharves at Weymouth Landing; thence to Braintree Bridge 80 feet wide, and above the bridge 50 feet wide, with increased width at each turn to facilitate the movement of vessels. The total length of channel to be improved was 7,000 feet, approximately, and the cost was estimated to be $40,000.

The project for the improvement of Weymouth Back River was submitted February 7, 1891. It proposed to dredge a channel through the outer bar 200 feet wide and 12 feet deep at mean low water, and to widen and deepen the natural channel of the river to the same dimensions to the wharf of the fertilizer company, at an estimated cost of $22,000.

On March 15, 1897, a project for the improvement of this river from the Bradley Fertilizer Company wharf up to Mann's wharf was submitted. It proposed a channel 60 feet wide, 4 feet deep at mean low water, at an estimated cost of $49,834.01.

This project was published as House Doc. No. 12, Fifty-fifth Congress, first session; also in Annual Report, Chief of Engineers, 1897, page 874.

No appropriation has as yet been made for its execution.

The total appropriations for this work to date have been $40,000, of which $12,500 must be expended in the Back River.

The expenditure to June 30, 1897, was $38,453.61.

At that date the channel in Weymouth Fore River was 6 feet deep and 60 feet wide up to Braintree Bridge, and above the bridge was completed except over a few small ledges uncovered by the dredging in 1897.

In Weymouth Back River the channel was 12 feet deep at mean low water, 200 feet wide through the bar, and 125 feet wide thence to the wharf of the Bradley Fertilizer Company.

The passage of vessels in both rivers had been greatly facilitated.

No operations have been in progress during the fiscal year, and at the date of this report the condition of the improvement is the same as on June 30, 1897.

The character of commerce benefited by the improvement of this river is the supply of coal, lumber, and general merchandise to the populous district surrounding it. The annual value of this commerce approximates $750,000.

July 1, 1897, balance unexpended	$1,546.39
July 1, 1898, balance unexpended	1,546.39
Amount (estimated) required for completion of existing project	22,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	12,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix B 12.)

13. Harbor at Scituate, Mass.—Scituate Harbor is on the west shore of Massachusetts Bay, 14 miles from either Boston or Plymouth lighthouses, and just southwest of the direct sailing course of all ocean-going vessels entering Boston Harbor.

Before improvement the harbor had a low-water area of 57 acres, approximately, more than 6 acres of which has a depth of at least 3

feet at mean low water. It was entirely open to the action of east winds, and the entrance was obstructed by many sunken bowlders. The depth on the bar was about 2½ feet at mean low water. The mean rise or fall of the tide is 9.8 feet.

The object of the improvement is to create a harbor of refuge for vessels bound to Boston which are too far south of their course to clear the dangerous ledges near Minots Light-House.

The project of improvement, adopted in 1881, is to build two rubble-stone breakwaters converging from opposite shores and to dredge an anchorage basin with channels connecting with the sea and the town wharves.

The north breakwater, from Cedar Point, is to be 800 feet long, and the south breakwater, from the point of the first cliff, is to be 730 feet long. Both breakwaters are to be 20 feet wide on top and 4 feet above mean high water, except at their outer ends, which are to be built 6 feet higher, to serve as sites for entrance beacons. The anchorage basin is to be 30 acres in area, approximately. The entrance channel is to be 2,700 feet long and 300 feet average width. The depths proposed were 15 feet in the entrance channel, 12 to 15 feet between the breakwaters, 12 feet immediately in rear of the south breakwater, and 10 feet for the anchorage basin. The channel leading to the town wharves is to be 3 feet deep, all at mean low water.

The estimated cost of the breakwaters was $100,000 and of the dredging $190,000.

The plan of the harbor, showing the proposed improvement, was published in the Annual Report of the Chief of Engineers for 1881, Part I, page 522.

The total amount appropriated for this work to date is $89,680, of which $1,180 was expended before the present project was adopted.

The expenditure to June 30, 1897, was $82,616.53.

At that time the condition of the improvement was as follows:

A portion of the beach between Cedar Point and the mainland was protected by a brush and stone bulkhead 450 feet long, in front of which was a stone apron 10 feet wide, 385 feet long. All known bowlders obstructing the entrance of the harbor were removed; the anchorage basin was 400 by 350 feet in area, 7 feet deep at mean low water; the entrance channel was 1,600 feet long, 100 feet wide, and 5 feet deep at mean low water; the channel connecting the basin with the town wharves was 3 feet deep at mean low water and 100 feet wide, except at the upper end, where for a distance of 75 feet it averaged only 50 feet wide; the north breakwater was 720 feet long, the south breakwater 450 feet long.

The harbor afforded a shelter for a number of small vessels.

A contract to dredge 14,000 cubic yards of material from the entrance channel was completed July 21, 1897.

The entrance channel was deepened to 7 feet at mean low water in a cut 100 feet wide. In all other respects the condition of the improvement at the date of this report is the same as on June 30, 1897.

July 1, 1897, balance unexpended	$5,883.47
June 30, 1898, amount expended during fiscal year	5,499.39
July 1, 1898, balance unexpended	384.08
Amount (estimated) required for completion of existing project	201,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix B 13.)

14. Plymouth Harbor, Massachusetts.—Plymouth Harbor is situated 30 miles south of Boston. Its outer anchorage, the "Cow Yard," is common to Plymouth, Kingston, and Duxbury, and is the only refuge for sea-going vessels from northeasterly gales when caught beween Boston and Provincetown, a distance of about 75 miles, following the coast line. The entrance to this outer anchorage is direct, unobstructed, of ample width, and sufficiently deep. The anchorage is capacious and has good "holding ground," but the extensive tidal basins inside of it give strong, variable currents across it.

The inner or harbor proper is formed by Long Beach, a narrow, low sand spit 3 miles long, which extends generally parallel to the mainland and about 1 mile from it.

The harbor contains about 2,000 acres, almost all of which is dry at low tide. A few narrow, crooked channels traverse these flats. They join about the center of the harbor, opposite the town wharves, and form the main ship channel (150 feet wide, approximately, and 10 feet deep at mean low water), which runs directly behind the northern half of Long Beach to the outer anchorage.

The maintenance of this inner harbor and channel depends on the preservation of Long Beach.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for the year 1888, Part I, page 460.

Before improvement about 6 inches depth of water could be carried to the town wharves at low tide.

Preivous to 1875 the project was a general one, and had for its object the preservation of Long Beach.

From the nature of the work it can at no time be considered completed, and small annual appropriations are necessary to repair any damages by storms. The various devices employed for this purpose are described in the Annual Report of the Chief of Engineers for 1877.

The project for the improvement of the harbor was first adopted in 1875. It provided for dredging a channel from the town wharves to the main ship channel 2,286 feet long, 100 feet wide, and 6 feet deep at mean low water. This project was modified in 1877 so as to include the dredging of a basin 866 feet long, 150 feet wide, and 8 feet deep directly in front of the town wharves.

In 1884 and 1885 it was proposed to deepen the channel and basin to 9 feet at mean low water and to make the channel 150 feet wide, at an estimated cost of $27,000, reduced in 1885 to $22,500.

On April 3, 1897, a plan and project for further improvement of the harbor were submitted, in accordance with the river and harbor act of June 3, 1896. This report and project were published as House Doc. No. 39, Fifty-fifth Congress, first session, also in Annual Report, Chief of Engineers, 1897, page 877.

From 1824 to date the amount appropriated for this harbor is $182,766.90, of which there had been expended to June 30, 1897—

For beach protection	$128,353.73
For dredging	50,514.89
Total	178,868.62

On June 30, 1897, the project of 1884–85 for improvement had been completed. Long Beach was in good order.

An examination of the dredged channel and basin was made in January, 1898.

No other operations were in progress during the fiscal year, and at the date of this report the dredged channel is in good order; but the basin has shoaled *by deposit from the mud flats* and Town Brook, so

that there is but 2 feet depth at mean low water at its upper end. Provision for the redredging of this basin is included in the project of April 3, 1897.

Long Beach is generally in good order, but several weak places were developed by last winter's storms and may require protection by bulkheads during this summer's season.

July 1, 1897, balance unexpended	$3,898.28
June 30, 1898, amount expended during fiscal year	949.34
July 1, 1898, balance unexpended	2,948.94

(See Appendix B 14.)

15. Harbor at Provincetown, Mass.—Provincetown Harbor is situated at the extremity of Cape Cod, about 40 miles southeast from Boston Light. It is one of the most valuable harbors of refuge on the Atlantic Coast. The entire commerce of New England and a very large local fishing interest are directly benefited by its maintenance, which depends entirely on the preservation of the sandy beaches which inclose it.

Since 1826 the project has been a general one, and provides for the preservation of the harbor by building dikes, bulkheads, and sand catches, and extensive planting of beach grass to repair or prevent storm damages to the beaches. From the nature of the work it can at no time be considered completed.

A full history of the improvement will be found in the Annual Reports of the Chief of Engineers for the years 1876, 1879, and 1886. A special dike across House Point Island Flats, to be built contingently, was recommended in the Annual Report for 1886.

A plan of the harbor was published in the Annual Report of the Chief of Engineers for 1886.

In October, 1896, a survey of the harbor was made in accordance with the river and harbor act of June 3, 1896, and on March 1, 1897, a plan and report of the survey were submitted with a project for strengthening the beach near Wood End Light, estimated to cost $13,200. This plan and report were published as House Doc. No. 8, Fifty-fifth Congress, first session; also in Annual Report, Chief of Engineers, 1897, page 878.

The total appropriations to date have been $155,918.44.

The amount expended to June 30, 1897, was $149,876.17.

At that date works of preservation had been built at Long Point, near Wood End Light, near Abel Hill, and at Beach Point, High Head, and Cove Section, and these works were all in good order and fulfill the purpose for which they were built, excepting the section near Wood End Light.

During the fiscal year the section near Wood End Light was strengthened by the construction of 227 feet of new bulkhead and some repairs to the old work.

No other operations were in progress during the fiscal year, and at the date of this report the beach and works of preservation are in good order; but the works protecting the northeastern end of Long Point will soon require extension to the northwest, and the section of the beach near Wood End Light can not be considered safe until the riprap recommended in the report of March 1, 1897, shall have been built.

July 1, 1897, balance unexpended	$6,042.27
June 30, 1898, amount expended during fiscal year	556.98
July 1, 1898, balance unexpended	5,485.29

(See Appendix B 15.)

16. Harbor at Chatham, Mass.—Chatham Harbor is at the eastern end of Nantucket Sound, about 15 miles east of Hyannis, Mass. Its outer anchorage (Chatham Roads) is a valuable harbor of refuge from northerly and easterly gales. The inner harbor (Stage Harbor) is small, but well landlocked, and has 8 to 12 feet depth at mean low water. Its entrance was obstructed by three bars, on which the greatest depth at mean low water was 4 feet.

The project for the improvement of this harbor, submitted December 19, 1890, proposes to dredge a channel through the three obstructing bars 6 feet deep at mean low water—100 feet wide at the inner bar, 150 feet wide at the middle bar, and 200 feet wide at the outer bar—at a cost of $10,000, increased in 1897 to $13,732.79.

The total appropriations to date have been $10,000.

The expenditure to June 30, 1897, was $4,426.10.

At that date the improved channel through the middle and inner bars was 100 feet wide, 6 feet deep at mean low water. Nothing had been done on the outer bar. At least 5 feet draft could be carried into the harbor at mean low water.

In this condition the improvement has facilitated the navigation of the harbor to a considerable extent.

In August, 1896, bids were invited for work to be done under a project for the expenditure of $5,000, appropriated by the river and harbor act of June 3, 1896, but none was received, and it was recommended that the funds available for this work be retained in the Treasury until further funds are provided under the increased estimate of March 24, 1897.

No operations were in progress during the fiscal year, and at the date of this report the condition of the improvement is the same as on June 30, 1897.

The character of the commerce involved in the improvement is the local fishing interest and supplies of lumber, coal, etc., for local consumption. The value of the commerce annually approximates $200,000.

July 1, 1897, balance unexpended	$5,573.90
July 1, 1898, balance unexpended	5,573.90
Amount (estimated) required for completion of existing project	3,732.79
Amount that can be profitably expended in fiscal year ending June 30, 1900	3,732.79
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix B 16.)

17. Removing sunken vessels or craft obstructing or endangering navigation.—Under the provisions of section 4 of the river and harbor act of 1880, the wreck of the schooner *Annie E. Rudolph*, sunk 2½ miles east by north of Orleans, Cape Cod, Massachusetts, was removed in August, 1897, at a total cost of $192.15; and the portion of the wreck of a vessel, name unknown, sunk in the channel of Old Harbor, Chatham, Mass., was removed in May, 1898, at a total cost of $397.31.

(See Appendix B 17.)

SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The surveys of the following localities, required by the river and harbor act of June 3, 1896, were made by the local engineer, Col. S. M. Mansfield, Corps of Engineers, and reports thereon submitted:

1. Survey of Merrimac River, Massachusetts, from Lowell to New Hampshire State line.—Colonel Mansfield submitted report of survey

dated January 8, 1898. He states that the river has a continuous depth of about 6½ feet for a least width of 250 feet between 6-foot contours; that it is easily navigable by the class of boats which use it; and that it seems to afford ample accommodations for the present and prospective navigation interests. In view of this, and in the absence of any indication by Congress of the dimensions of channel intended, he submits no estimate for improvement of the stream. The report was transmitted to Congress and printed in House Doc. No. 242, Fifty-fifth Congress, second session. (See also Appendix B 18.)

2. *Survey of Boston Harbor, Massachusetts, with a view to securing a channel 1,200 feet wide and 30 feet deep from the navy-yard to the entrance of the present main ship channel, and from the main ship channel in President Roads through Broad Sound Channel.*—Colonel Mansfield submitted report of survey dated November 19, 1897. The present project for improvement of this locality, providing for a channel 1,000 feet wide and 27 feet deep, is now being executed, and at the time of the survey there had been secured a channel of the full depth and width from the entrance of the harbor to Bug Light, 800 feet wide from Bug Light to the passage between Georges and Gallops islands, and thence 550 feet wide through the Narrows to President Roads.

Colonel Mansfield states that a great deal of rock in place will still have to be removed from the main ship channel to complete the present work of excavation; and to enlarge this channel to the contemplated dimensions will, it is estimated, cost $1,557,621.72. The estimated cost of enlarging the channel from the navy-yard to President Roads is $1,644,553.90. The proximity of the deep water of Broad Sound and President Roads has suggested the possibility of a direct and superior entrance to Boston Upper Harbor, and Colonel Mansfield is of opinion that the channel between them could be readily improved to the dimensions required, at a small cost compared with the expense of improving the channel through the Narrows. The cost of this new channel through Broad Sound is estimated at $481,941.57.

For reasons given in the report, Colonel Mansfield is of opinion that the harbor is worthy of improvement to the extent of providing a channel 1,200 feet wide and 30 feet deep from the navy-yard to President Roads, and from President Roads through Broad Sound Channel, and that work on the latter portion should be executed first. Owing to the difficulties and expense attending the work he does not recommend the increasing of the dimensions of the lower main ship channel, as it is thought that the proposed improvement of the Broad Sound Channel will amply meet the requirements of navigation. The report was transmitted to Congress and printed in House Doc. No. 133, Fifty-fifth Congress, second session. (See also Appendix B 19.)

IMPROVEMENT OF RIVERS AND HARBORS IN SOUTHEASTERN MASSACHUSETTS AND RHODE ISLAND.

This district was in the charge of Maj. D. W. Lockwood, Corps of Engineers, having under his immediate orders Lieut. Charles H. McKinstry, Corps of Engineers, to January 23, 1898, Lieut. William J. Barden, Corps of Engineers, from March 14 to April 15, 1898, Lieut. William B. Ladue, Corps of Engineers, since April 15, 1898, and Lieut. Chester Harding, Corps of Engineers, since May 9, 1898. Division Engineer, Brig. Gen. G. L. Gillespie, U. S. Volunteers, colonel, Corps of Engineers.

1. *Harbor of refuge at Hyannis, Mass.*—This harbor before improvement was an open roadstead, exposed to southerly storms. In the years

1827–1838 a breakwater of riprap granite 1,170 feet long was constructed, covering an anchorage of about 175 acres, the entrance to which has a depth of about 15.5 feet. Between the years 1852 and 1882 extensive repairs were made, increasing the width of its base and the size of the stone forming its sides and top.

The approved project of 1884 provided for dredging to 15.5 feet depth at low water about 36 acres area north of the existing breakwater, so as to increase the deep-water harborage by that amount; all at a total cost estimated at $45,743.20.

At the adoption of the present project the 15.5 feet depth anchorage covered only about 47 acres, and the 36 additional acres to be dredged carried an average of about 12 feet depth of water at low water.

The sum of $160,749.64 had been expended at this harbor up to June 30, 1897, of which $123,350.62 had been expended in construction and repairs to the breakwater and $37,399.02 in dredging in the anchorage area, by which 23 acres out of 36 had been dredged.

Twenty-five thousand eight hundred and three cubic yards of mud and sand was dredged during the past fiscal year under contract, adding about 3.6 acres to the deepened anchorage area.

The principal value of this harbor to commerce is as a harbor of refuge for coasters and fishing vessels. About 2,700 vessels of various kinds used the harbor last year. The actual commerce of the place consists of general agricultural products, coal, and fish, aggregating 25,020 tons. The increase of anchorage area will afford refuge for more and larger boats.

The unexpended balance will be applied to contingencies.

July 1, 1897, balance unexpended	$6,202.86
June 30, 1898, amount expended during fiscal year	6,065.51
July 1, 1898, balance unexpended	137.35
Amount (estimated) required for completion of existing project	2,162.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	2,162.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix C 1.)

2. *Harbor of refuge at Nantucket, Mass.*—This harbor is the only one between the harbor of Marthas Vineyard (Vineyard Haven and Edgartown) and Provincetown, a distance of 100 miles, except the small harbor of Hyannis, on the north side of Nantucket Sound. It has a considerable area with a depth of water in excess of 12 feet, and the object of improvement is to make it a harbor of refuge for vessels plying between ports north and south of Cape Cod.

The approved project of 1880, as modified in 1885, provides for the construction of two jetties as training walls, one on each side of the harbor entrance, planned so as to allow the tidal currents to assist in scouring out and maintaining a good channel, and for the completion of the work by dredging where necessary to obtain a depth of from 12 to 15 feet at low water in this channel; all at a total cost estimated at $375,000, of which $220,000 was appropriated prior to 1896.

At the adoption of the present project no jetties existed and the channel entrance was barred by a shoal of 1.5 miles width, on which there was only 6 feet depth of water at low tide, the channel being very crooked and subject to changes in location.

During an unusually severe storm in December, 1896, a breach was made through the Haulover Beach between the ocean and the head of the harbor, and it was decided to extend the western jetty rather than build *up to full height portions of the east jetty.*

The sum of $263,026.53 had been expended on this work up to June 30, 1897, of which $45,734.75 had been expended in ineffectual dredging between 1829 and 1844, and the balance, $217,291.78, in jetty construction, by which the west jetty had been built to 4,255 feet length, of which 3,955 feet was to full height and the remaining 300 feet had been built to partial section; the east jetty had been built to 834 feet length, with full height, then the foundation laid for a length of 191 feet, then came a gap of 160 feet, beyond which 1,300 feet length had been raised to half-tide level, and then 2,145 feet length raised to 1.5 feet below the level of mean low tide and the remaining distance of 210 feet raised to 1.5 feet below mean low water; the total length from shore end to outer end being now 4,840 feet. A mound of heavy stone had been built near the present end of this jetty to protect a lantern staff.

During the past fiscal year 9,625 tons of stone was placed in the west jetty, extending the same by about 1,000 feet, and raising it to the level of 1.5 feet below mean low water with mounds every 200 feet extending above high water. The jetty light was moved to the end of the new work.

Further work will consist in extending the west jetty.

The entire commerce of Nantucket Island is carried on at this harbor, amounting in 1897 to 16,701 tons. Twelve hundred and fifty-five vessels entered and left it during this year. The effect on commerce of this work will be to afford a place of refuge easy of access and secure from storms for coasters and fishing vessels.

July 1, 1897, balance unexpended	$22,708.22
June 30, 1898, amount expended during fiscal year	21,689.98
July 1, 1898, balance unexpended	1,018.24
July 1, 1898, outstanding liabilities	85.65
July 1, 1898, balance available	932.59
Amount (estimated) required for completion of existing project	135,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix C 2.)

3. Harbor at Vineyard Haven, Mass.—Vineyard Haven is a deep indentation in the northern shore of the island of Marthas Vineyard, on the southern side of Vineyard Sound. The approved project of 1887, as modified in 1889, provides for the protection of the "chops" (or headlands) from erosion and the intervening harbor from being filled by the eroded material, the whole to be done by means of stone sea walls and jetties to be built along the beach in front of the bluffs at both headlands. The total cost was estimated in 1889 at $60,000, of which $50,000 was appropriated prior to 1896.

At the adoption of the present project the headlands were gradually wearing away and the adjacent parts of the harbor were shoaling. No protection works were in existence.

The sum of $42,833.30 had been expended on this work up to June 30, 1897, by which there had been built a sea wall of 960 feet length and a jetty of 50 feet length and five small spurs extending back from the sea wall to the foot of the bluff at the East Chop, and at the West Chop a sea wall of 880 feet length, three jetties of 150, 135, and 280 feet length, a wharf, and a short breakwater of 60 feet length, and 270 feet length of riprap wall along the low-water line in front of the bluff

on the east side of the West Chop. The works so far constructed appear to have afforded the needed protection.

During the past fiscal year work was continued under contract for the further construction of the riprap walls and jetties, and was completed on September 30, 1897. Four thousand nine hundred and seventy-four tons of stone was placed, by which 2,130 feet of riprap wall was constructed along the low-water line in front of the bluff on the east side of the West Chop, and 13 short jetties running in from the sea wall to the foot of the bluff; and on the East Chop 250 feet of sea wall was constructed, together with one jetty running into the foot of the bluff, completing all proposed work.

The unexpended balance will be applied to contingencies.

The commerce of the harbor in 1897 amounted to 73,862 tons. The benefit to commerce of this work is the preservation of the anchorage area and harbor generally from shoaling.

July 1, 1897, balance unexpended	$14,166.70
June 30, 1898, amount expended during fiscal year	10,697.96
July 1, 1898, balance unexpended	3,468.74
Amount (estimated) required for completion of existing project	3,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix C 3.)

4. *Woods Hole Channel, Massachusetts.*—Woods Hole is a waterway or strait connecting Buzzards Bay and Vineyard Sound and lying near the southwestern part of Cape Cod, Massachusetts. The name is also applied to the village and harbor in the near vicinity.

Before improvement the entrance to Little Harbor was obstructed by a bar with but 7.5 feet on it at mean low tide. Great Harbor has ample depth. In the strait the channels were crooked and obstructed by bowlders, and the velocity of the currents at certain stages of the tide was from 4 to 5 miles per hour. The site of the wharves and basins of the United States Fish Commission and Revenue Marine was a submerged point of land extending from the shore of the harbor.

The project of 1879 provided for making a channel through the bar at the entrance to Little Harbor and widening and deepening the channel through the strait. The project of 1883, extended in 1884 and 1886, provided for the construction of retaining walls on shore, a stone pier, and a wooden wharf, mainly for the use of the United States Fish Commission, and incidentally for the use of the other branches of the public service, all of which work had been completed prior to 1889. The project of 1895, the present approved project, provided for deepening the channel through the strait to 13 feet at mean low water and widening same to 300 feet, estimated to cost $396,000.

The amount expended on this work prior to the present fiscal year was $113,621.91, with which the entrance to Little Harbor had been dredged to 10 feet depth, and a direct channel to 9 feet depth had been dredged through the strait where none previously existed; the retaining walls, stone pier, and wooden wharves had also all been built and repaired; a contract had been entered into for the deepening and widening of a direct channel through the strait.

During the past fiscal year the work done under contract resulted in making two cuts each 35 feet wide and 13 feet deep through the shoal at the eastern entrance to the channel; 2,450.68 cubic yards of bowlders and sand was removed.

The commerce of Woods Hole was 14,823 tons for 1897, no account being kept of vessels passing through the strait. The deepening of this channel will result in more vessels using it than formerly.

July 1, 1897, balance unexpended	$19,978.01
June 30, 1898, amount expended during fiscal year	19,955.50
July 1, 1898, balance unexpended	22.51
Amount (estimated) required for completion of existing project	376,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	75,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix C 4.)

5. *New Bedford Harbor, Massachusetts.*—New Bedford Harbor is an estuary of Buzzards Bay, and is the port of the cities of New Bedford and Fairhaven.

Before improvement the channel had a depth of 12.5 feet at mean low water. The projects of 1874 and 1877 provided for a channel 300 feet wide and 15 feet deep at mean low water from the deep water just above Palmers Island to the wharves of New Bedford. This work was completed in 1877 at a cost of $20,000.

The project of 1887 provided for a channel 200 feet wide and 18 feet deep from Buzzards Bay to New Bedford, at an estimated cost of $35,000, and has been completed.

The approved project of 1895, under which work is now being carried on, provides for dredging an anchorage area one-half mile long, 600 feet wide, and 18 feet deep at mean low tide on the north side of the channel leading from Fairhaven to New Bedford, at an estimated cost of $57,689.33.

At the adoption of the present project the anchorage area was from 12 to 18 feet deep.

The sum of $80,643.08 had been expended on this work up to June 30, 1897, by which a channel 200 feet wide and 18 feet deep at mean low tide had been secured from the deep water of Buzzards Bay to New Bedford, and 11 acres of the anchorage area dredged.

No operations were in progress during the fiscal year, the amount expended being applied to payment of liabilities outstanding at close of last fiscal year.

There were 5,600 vessels in the harbor during the year 1897, with a total tonnage of 668,165. The effect of the deep water on commerce is the use of deeper draft vessels than formerly, larger cargoes, and a consequent reduction in water freight charges.

July 1, 1897, balance unexpended	$2,057.29
June 30, 1898, amount expended during fiscal year	1,944.42
July 1, 1898, balance unexpended	112.87
Amount (estimated) required for completion of existing project	47,689.33
Amount that can be profitably expended in fiscal year ending June 30, 1900	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix C 5.)

6. *Canapitsit Channel, Massachusetts.*—This waterway lies about 20 miles south of New Bedford, running between the islands of Cuttyhunk and Nashawena, and connecting the waters of Vineyard Sound and Buzzards Bay.

The object of the improvement is to make this channel safe for the

use of light-draft sail boats, and also especially of the surf boats belonging to the life-saving station of this dangerous locality.

The approved project of 1891 provides for the widening and deepening of the present channel from Vineyard Sound to Buzzards Bay between the islands of Nashawena and Cuttyhunk, Massachusetts, so as to secure a depth of 6 feet at low water, with a least width of 150 feet over its entire length, at a total cost estimated in 1893 at $9,800, all of which had been appropriated prior to 1895.

At the adoption of the present project the sand shoals, and especially the numerous bowlders, made this passage specially dangerous to the life-saving station boats and other shallow-draft row and sail boats.

The sum of $5,236.04 had been expended on this work up to June 30, 1897, by which a channel of about 66 feet width and at least 5 feet depth at low water had been cut entirely across the shoal, completing about half of the proposed work.

During the past fiscal year the work under contract was completed; 5,638 cubic yards of sand, gravel, and small bowlders and 89.108 cubic yards of large bowlders were removed from the channel. This completed the channel to its full dimensions.

The number of vessels passing through this channel is reported as 2,570, and the commerce at Cuttyhunk as 3,128 tons.

July 1, 1897, balance unexpended	$4,563.96
June 30, 1898, amount expended during fiscal year	2,529.00
July 1, 1898, balance unexpended	2,034.96
July 1, 1898, outstanding liabilities	1,152.55
July 1, 1898, balance available	882.41

(See Appendix C 6.)

7. *Taunton River, Massachusetts.*—This river rises in Norfolk County, Mass., and empties into Narragansett Bay at Fall River. The object of the improvement is to deepen and widen the channel leading to the city of Taunton, at the head of navigation, so that vessels of 11 feet draft can reach the city at high water.

In its original condition the channel was narrow and obstructed by bowlders, and from Berkley Bridge to Taunton the depth was in places not more than 5 feet at mean high water. A vessel of 30 tons burden was as large as could go up to Taunton.

From 1870 to 1879, $63,000 was appropriated to secure 9 feet depth at high water. This work was completed in 1879.

The approved project of 1880 provides for the widening and deepening of the river so as to secure a channel of at least 12 feet depth at high water, with 100 feet width from its mouth up to Berkley Bridge (above Dighton); thence 12 feet depth with 80 feet width (100 feet width at bends) up to Briggs Shoal; thence 11 feet depth with 80 feet width up to the shipyard; thence 11 feet depth with 60 feet width up to Weir Bridge, Taunton; all at a total cost estimated in 1893 at $125,000, of which $113,000 was appropriated prior to 1896.

At the adoption of the present project the channel was limited to 9 feet at high water and was too narrow and too much obstructed by bowlders for easy navigation by the craft making use of it.

The sum of $180,510.11 had been expended on this work up to June 30, 1897, by which expenditure a large part of the proposed work had been done, especially at the places most complained of by vessels using this river. Vessels of 11 feet draft could reach Taunton, the head of navigation.

No work has been in progress during the year. To complete the existing project dredging is required at a few points in the Needles and lower down the river, to widen and straighten the channel, and the removal of a small amount of ledge rock.

The unexpended balance on hand will be held until further appropriation is made.

The work done has enabled larger vessels to go up the river.

July 1, 1897, balance unexpended	$489.89
July 1, 1898, balance unexpended	489.89
Amount (estimated) required for completion of existing project	7,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	7,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix C 7.)

8. *Sakonnet River, Rhode Island.*—Sakonnet River is an arm of the sea between the island of Rhode Island and the mainland, extending from the ocean to Narragansett Bay around the head of Rhode Island. It is at present obstructed at its upper end by two causeways extending across it; these causeways have draw openings which are of insufficient width and depth for the needs of commerce, and besides offer such obstruction to the ebb and flow of the tides that the currents through them make the passage dangerous even to boats of such dimensions as could pass through them under ordinary circumstances.

The present approved project provides for increasing the width and depth of the draw opening in the Stone Bridge, owned by the State of Rhode Island, so as to provide an opening 100 feet wide and 25 feet deep at mean low water, estimated to cost $40,000.

The New York, New Haven and Hartford Railroad Company has been notified by the Secretary of War to construct a suitable draw in its bridge by May 1, 1899.

July 1, 1897, balance unexpended	$20,000.00
July 1, 1898, balance unexpended	20,000.00
Amount (estimated) required for completion of existing project	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix C 8.)

9. *Pawtucket River, Rhode Island.*—This river, otherwise called Seekonk River, is the upper portion of Providence River, and extends from Pawtucket to Providence. Before improvement the channel in the river had a ruling depth of about 5 feet at mean low water.

Between 1867 and 1873, $52,000 was appropriated to dredge the channel to 7 feet depth. This work was finished in 1876.

The approved project of 1883 provides for the deepening of the river so as to secure a channel of at least 12 feet depth at low water, with 100 feet width from its mouth at Providence up to opposite Grant & Co.'s wharf at Pawtucket, and thence 12 feet depth with 40 feet width through a stone ledge for a short distance farther to Pawtucket Bridge; all at a total cost estimated in 1883 at $382,500, of which $205,000 was appropriated prior to 1895.

At the adoption of the present project the channel was narrow and only about 5 feet deep.

The sum of $253,948.39 had been expended on this work up to June 30, 1897, by which a channel had been secured 100 feet in width and 12 feet in depth from the mouth of the river near Providence up to the lower wharves of the city of Pawtucket; thence a channel of 40 feet

width and 12 feet depth had been completed through the ledge rock to the head of the river, with the exception of a little more than one-third of the needed work in the upper section.

During the fiscal year work was in progress through the upper section of ledge rock, and the channel was completed to full width of 40 feet and depth of 12 feet.

The effect of the improvement will be to cause the use of vessels of deeper draft than formerly, larger cargoes, and cheaper rates. The completed portion of the channel has already been a great benefit to the commerce of the river, which, in 1897, amounted to a tonnage of 200,000.

The work yet to be done is to straighten and deepen the channel in its lower portions.

July 1, 1897, balance unexpended	$23,571.20
June 30, 1898, amount expended during fiscal year	12,443.03
July 1, 1898, balance unexpended	11,128.17
Amount (estimated) required for completion of existing project	30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix C 9.)

10. Providence River and Narragansett Bay, Rhode Island.—The object of this improvement is to furnish a wide and deep channel for foreign and coastwise commerce from the ocean to Providence.

Before the improvement of the river was commenced in 1853 many shoals obstructed navigation, and at one point in the channel, a place called "The Crook," the available low-water depth was but 4.5 feet. Between 1852 and 1873, $56,500 was appropriated, to secure first 9 and then 12 feet depth of channel. This work was finished in 1873.

The approved project of 1878, as modified in 1882, provides for the deepening of the river and the deepening and widening of its anchorage basins, so as to secure a channel of at least 25 feet depth at low water with 300 feet width from the deep water of Narragansett Bay up to Providence, R. I., and so as to secure anchorage basins of 20 feet depth with 600 feet width, 18 feet depth with 725 feet width, 12 feet depth with 940 feet width, and 6 feet depth with 1,060 feet width from Fox Point to Field Point; all at a total cost estimated in 1882 at $675,000.

At the adoption of this project the channel was limited to 12-foot depths, and the anchorage areas were much too small and shallow for the craft seeking them.

The river and harbor act of June 3, 1896, provides for securing a ship channel 400 feet in width and of a depth of 25 feet at mean low water from Sassafras Point, in Providence Harbor, through Providence River and Narragansett Bay by the most direct route practicable to the ocean, by way of the "Western Passage," so called, at an estimated cost of $732,820.

The item in the act is as follows:

Improving Providence River and Narragansett Bay, Rhode Island: Continuing improvement, according to the report of the Chief of Engineers, dated April ninth, eighteen hundred and ninety-six, twenty-five thousand dollars: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary for the completion of such project, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate seven hundred and seven thousand dollars, exclusive of the amount herein and heretofore appropriated.

The sum of $698,490.60 had been expended on this work up to June 30, 1897, by which Bulkhead Rock had been removed and the channel 300 feet wide and 25 feet deep had been secured to the city of Providence, and an anchorage area 1,060 feet wide, with depths varying from 6 to 20 feet, had been dredged; but both the channel and anchorage area now need some redredging.

A contract is in force for dredging the river channel between Sassafras and Conimicut points. No contract has yet been made for work in the Western Passage.

During the past fiscal year dredging has been in progress on the 400-foot channel between Sassafras Point and Conimicut Point, and 745,655 cubic yards of mud and gravel was removed.

A survey of the Western Passage was made for the purpose of securing data for the balance of projected work, and the map is now being platted.

The available unexpended balance will be applied to continuing the dredging in the new ship channel.

The improvement has been of great benefit to commerce, which has increased over past years. Eleven thousand two hundred and fifty-six vessels of all classes have entered the river, carrying a total tonnage of 2,152,975.

July 1, 1897, balance unexpended		$143,152.79
Amount appropriated by sundry civil act approved July 1, 1898		125,000.00
		268,152.79
June 30, 1898, amount expended during fiscal year		73,128.78
July 1, 1898, balance unexpended		195,024.01
July 1, 1898, outstanding liabilities	$17,050.70	
July 1, 1898, amount covered by uncompleted contracts	20,498.87	
		37,549.57
July 1, 1898, balance available		157,474.44
Amount (estimated) required for completion of existing project		457,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900		400,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix C 10.)

11. Removal of Green Jacket Shoal, Providence, R. I.—This shoal is in that part of Providence River which constitutes the harbor of Providence. It lies off the wharves, on the south front of the city, and occupies a part of the harbor that is required for anchorage purposes, covering an area of about 18 acres between the 15-foot curves and about 30 acres in all.

The approved project of 1885 provides for the removal, to 25 feet depth at low water, of a middle-ground shoal of about 30 acres area in Providence River, opposite the city, the portion to be removed to be at least 200 feet distant from the harbor lines of the city; all at a total cost estimated in 1885 at $112,346.

At the adoption of the present project the shoal in many places carried only 1 foot of water and was a very troublesome obstruction.

The sum of $103,896.99 had been expended on this work up to June 30, 1897, by which 23.8 acres out of the original 30 of this shoal had been dredged to 25 feet depth, and a 16-foot depth had been secured over the central and largest portion of the shoal, in addition to a 20-foot depth in the main channel, making an important addition to the anchorage facilities of Providence Harbor.

No work has been in progress during the year.

The removal of this shoal will enable vessels to anchor outside of the channel and thus remove an obstruction to vessels going to or from the Providence wharves.

July 1, 1897, balance unexpended	$353.01
June 30, 1898, amount expended during fiscal year	20.75
July 1, 1898, balance unexpended	332.26

Amount (estimated) required for completion of existing project	8,096.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	8,096.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix C 11.)

12. Harbor at Wickford, R. I.—Wickford Harbor is an arm of Narragansett Bay, about 18 miles south of Providence and 12 miles northwest of Newport. It is the water terminus of the Wickford Railroad, which connects with the New York, New Haven and Hartford Railroad at Wickford Junction, and in connection with a ferry route from Wickford to Newport forms the shortest line of communication between Newport and New York and other points west.

The present approved project of 1896 provides for the removal of certain bowlders and deepening the harbor by dredging.

The sum of $15,563.89 had been expended on this improvement up to June 30, 1897, which removed some of the bowlders from the entrance to the harbor, and gave a channel 60 feet wide and 9 feet deep at mean low water, with enlargements at the bends up to the wharves in Wickford.

The unexpended balance is to be applied to removing a few additional bowlders.

July 1, 1897, balance unexpended	$736.11
July 1, 1898, balance unexpended	736.11

(See Appendix C 12.)

13. Newport Harbor, Rhode Island.—This harbor is at the main entrance to Narragansett Bay, and all the year it serves as an easily accessible harbor of refuge to foreign and coastwise commerce.

Before improvement the capacity of the inner harbor was limited by shoals, and it was not adequate to the number and size of the vessels seeking it for refuge. The southern or main entrance was obstructed by a bar which stretched out from Goat Island, and the northern entrance by a sharp rocky spit near Rose Island, and the general business wharves of the city could not be reached at low tide by vessels drawing more than 8 feet.

Between 1873 and 1875 $28,500 was appropriated to secure 12 feet depth in the harbor. This work was completed in 1876.

The approved project of 1880, as modified in 1882, 1883, 1884, 1890, and 1895, provides for the widening and deepening of the channel from Narragansett Bay into Newport, so as to secure 15 feet depth at low water with at least 750 feet width; for the extension of the 13-foot depth and 10-foot depth anchorage basins; for the partial cutting off of the shoal spit at the southern end of Goat Island, and for the construction of jetties on the western shore of Goat Island so as to protect the end of this island from erosion and to prevent the drift of sand, etc., around the island into the adjacent parts of the channel and harbor, and the

removal of Spindle Rock, a sharp rocky spit near Rose Island; all at a total cost estimated in 1895 at $206,200.

At the adoption of the present project this harbor was limited to 12 feet depth at low water, and its anchorage area was too small for the craft seeking harborage at this place during the summer and all the year during storms.

The sum of $180,422.80 had been expended on this work up to June 30, 1897, by which the 15-foot channels and 13-foot anchorage basins had been completed, the shoal spit at the southern end of Goat Island had been cut off, and one jetty 133 feet long had been built westward from Goat Island. The southern entrance had been completed for vessels of 15 feet draft, and of the total area to be dredged within the harbor (about 90 acres) about 75.25 acres had been completed, and 409.14 cubic yards of rock had been removed from Spindle Rock, securing a depth of 8.5 feet at low water over the remaining portion of the rock.

No dredging or stonework was in progress during the past fiscal year, for want of funds.

A survey of the water front of the harbor was made and two public hearings were held in connection with the establishment of harbor lines.

The work required to complete the existing projects is the excavation of a small remaining portion of the 10-foot anchorage area; also the building of additional jetties outside of Goat Island, whenever they may be required to arrest the drift of littoral sand and gravel into the harbor entrance.

As the improvement of this harbor has progressed there has been a large increase in the size and number of vessels using the harbor. The commerce for 1897 shows a tonnage of 434,900, principally fish, coal, and general merchandise.

July 1, 1897, balance unexpended	$85.72
June 30, 1898, amount expended during fiscal year	76.70
July 1, 1898, balance unexpended	9.02

Amount (estimated) required for completion of existing project	54,200.00
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	25,000.00

(See Appendix C 13.)

14. Harbor of refuge at Point Judith, Rhode Island.—Point Judith is the southeastern extremity of South Kingston, R. I., and marks the southwestern entrance to Narragansett Bay. A long ledge, known as Squid Ledge, extends for nearly a mile in a south by easterly direction, about 1.5 miles west of the point.

The approved project of 1889 provides for the construction of a national harbor of refuge, nearly a mile square at this point, by means of stone breakwaters, built partly on Squid Ledge and planned so as to give protection against easterly, southerly, and westerly storms, the mainland itself forming a protection on the north, all at a total cost estimated in 1889 at $1,250,000, all of which has been appropriated.

By the act of July 13, 1892, authority was given to the Secretary of War to make contracts for the completion of the project, on the basis of the above-estimated total cost, the work to be paid for as appropriations may from time to time be made by law.

At the adoption of the project this point was a specially dangerous

place for boats and tows to pass during storms and even ordinarily bad weather.

The sum of $900,093.82 had been expended on this work up to June 30, 1897, by which the breakwater had been commenced at its center, extended to a total length of about 5,760 feet on the bottom, of which 3,860 feet of the eastern arm had been built up to its full height and width on top, and an additional length of 200 feet sloping off from the eastern end had been built, making the entire length of the eastern arm 4,060 feet on the bottom. The remaining 1,700 feet in the western arm was built well above the level of high water, and the greater part of this up to the full height of 10 feet above mean low water. Three beacon lights had been established and maintained on the built-up portions of the breakwater.

During the past fiscal year 130,791.76 tons of stone was placed in the breakwater (making 765,813.76 tons in all), the greater portion of which was used to complete the 200 feet at eastern end to full dimensions and to build up the sea slope of 1 on 2 on the east wing, and the remainder used to build up and extend the western arm, which now has a length on the bottom of 2,100 feet from the central beacon.

It is reported that over 69,000 vessels passed the harbor during the year 1897, with a tonnage of 33,980,000.

The limit of cost of this improvement, as fixed by law, was based on an estimate prepared in 1889 from the best information then available. Experience and additional information gained since that time showed that if the breakwater was to be completed to the extent proposed, the original estimate must be revised and materially increased.

The total amount of the original estimated cost having been appropriated, an estimate of $444,310.98 is submitted as the additional sum that will be required to complete the breakwater.

It is proposed to apply the balance available to continuing the construction of the breakwater.

July 1, 1897, balance expended		$349,944.79
June 30, 1898, amount expended during fiscal year		151,173.21
July 1, 1898, balance unexpended		198,771.58
July 1, 1898, outstanding liabilities	$46,243.96	
July 1, 1898, amount covered by uncompleted contracts	135,746.42	
		181,990.38
July 1, 1898, balance available		16,781.20
Amount (estimated) required for completion of existing project		444,310.98
Amount that can be profitably expended in fiscal year ending June 30, 1900		100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix C 14.)

15. Entrance to Point Judith Pond, Rhode Island.—Point Judith Pond is a shallow-draft salt pond, lying in rear of the sandy beach of the Rhode Island shore, just west of Point Judith.

The improvement desired at this place by the people of the neighborhood is the reopening of an old entrance long ago closed by the ocean storms.

The present entrance to this pond is very shallow (less than 3 feet), crooked, and variable in location, and lies about a mile west of the former entrance.

There is at present no approved project for the improvement of this pond entrance.

Up to June 30, 1897, $518.38 had been expended in surveys.

July 1, 1897, balance unexpended	$9,481.62
July 1, 1898, balance unexpended	9,481.62

(See Appendix C 15.)

16. Harbor of refuge at Block Island, Rhode Island.—This island is about 14 miles east of the eastern end of Long Island, and about 10 miles distant from the nearest point of the mainland.

The object of the improvement is to furnish a harbor of refuge for medium-draft vessels engaged in foreign and coastwise commerce.

Before the construction of the present harbor Block Island had no harbor which afforded protection for decked vessels.

Between 1870 and 1876 $285,000 was appropriated for a breakwater for a harbor for medium draft vessels, this work being completed in 1878. Between 1880 and 1882 $25,000 was appropriated for dredging an inner basin and the protection of the shore next the breakwater, this work being completed in 1884. In 1884 $15,000 was appropriated for additions to the old breakwater, this money being so spent and work completed in 1884–85.

The approved project of 1884, as modified in 1888, provided for the construction of a harbor of refuge on the eastern side of the island, consisting of an enlarged inner harbor (or basin) 800 feet square for small vessels and an exterior harbor for larger ones, at a total cost estimated in 1888 at $75,000. This project was practically completed in 1893.

The present approved project, that of 1895, based on the report of the survey ordered in the river and harbor act of August 18, 1894, provides for raising the entire breakwater to proper height and stopping sand leaks between certain points, and dredging the main inner harbor to a depth of 10 feet, at an estimated cost of $83,985.

At the adoption of the present project this harbor was neither large enough nor well enough protected for the proper harborage of the craft seeking refuge at this place during storms and bad weather.

The sum of $401,824.36 had been expended on this work up to June 30, 1897, and under the project of 1888 the gap in the old breakwater had been filled up so as to make the breakwater of 1,900 feet total length; the sea walls of the inner harbor had been completed (except as to stone fender piers at the entrance); wooden fender piers had been built for present uses; the worst rocks and bowlders had been removed from the new inner harbor; the shoal west of the breakwater had been dredged to a depth of 9 feet from the steamboat wharf to within 100 feet of the north wall, and the entrance to the inner harbor, which had shoaled up from the drift of sand through the main breakwater, had been partially dredged to a depth of 12 feet and redredged to 10 feet depth. In June, 1897, it became necessary to again dredge this shoal, and 2,258 cubic yards of material had already been removed.

During the past fiscal year the work of dredging the entrance to the inner harbor, which was in progress at the beginning of the fiscal year, was completed to a depth of 10 feet at low water by the removal of 2,742 cubic yards of sand.

It is proposed to hold the unexpended balance to be applied to keeping the entrance clear by dredging.

The increase of depth at entrance has enabled a larger class of vessels to use the harbor, and since the completion of the breakwater a greater number of vessels use the harbor for refuge. In 1897, 17,280

vessels used the harbor, and the commerce amounted to 51,714 tons, an increase over previous years.

July 1, 1897, balance unexpended	$4,675.64
June 30, 1898, amount expended during fiscal year	2,268.77
July 1, 1898, balance unexpended	2,406.87
July 1, 1898, outstanding liabilities	30.00
July 1, 1898, balance available	2,376.87
Amount (estimated) required for completion of existing project	78,985.00
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	25,000.00

(See Appendix C 16.)

17. Great Salt Pond, Block Island, Rhode Island.—The Great Salt Pond is located about the center of Block Island, and contains a large anchorage area for deepest-draft vessels. The State of Rhode Island and town of New Shoreham have appropriated altogether $115,000 toward securing a channel connecting it with the ocean on the west. The channel, under the approved project of 1895, is to be 600 feet wide and to have a central depth of 25 feet for a width of 150 feet, sloping gradually to 12 feet in a width of 504 feet; the channel seaward to be protected on the south by a jetty extending to the 18-foot contour, and on the north by a jetty about 500 feet long.

With the funds appropriated by the local authorities a channel has been dredged 450 feet wide with a minimum width of 150 feet, carrying 12 feet depth at mean low tide; a jetty on the south side of the channel has been built out 837 feet, and on the north side about 250 feet from the shore.

Under governmental improvement, and up to June 30, 1897, the sum of $26,890.24 had been expended and the south jetty had been extended 1,262 feet from the shore, or out to the 18-foot contour.

During the fiscal year 1,200 tons of stone was placed in the south jetty, building up all low portions of the jetty to full width and height, and completing all work contracted for.

The opening of this harbor has been of great benefit commercially, the commerce of 1897 amounting to 9,700 tons.

There remains to complete the existing project the further dredging of the channel and construction of the north jetty.

July 1, 1897, balance unexpended	$13,109.76
June 30, 1898, amount expended during fiscal year	10,978.59
July 1, 1898, balance unexpended	2,131.17
July 1, 1898, outstanding liabilities	50.00
July 1, 1898, balance available	2,081.17
Amount (estimated) required for completion of existing project	57,567.94
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	25,000.00

(See Appendix C 17.)

18. Removing sunken vessels or craft obstructing or endangering navigation.—1. Schooner R. L. Dewis.—This schooner was sunk by collision during July, 1897, in Vineyard Sound, midway between Hedge Fence and Squash Meadow shoals. Her removal was completed by the Government force and plant on September 25, 1897.

2. Schooner Mary B. Smith.—This schooner was sunk during October, 1897, in about 10 feet of water in Vineyard Haven Harbor, and its removal accomplished in November, 1897, by hired labor and use of the Government plant.

3. Wreck off Quonocontaug, R. I.—The spars of an unknown wreck were reported in March, 1898, as an obstruction to navigation, about 4 miles south of the Quonocontaug Life Saving Station. Their removal has been authorized and will be accomplished during the early part of the next fiscal year.

4. Schooner Asia.—This schooner was sunk on Killpond Bar during March, 1898, about 1 mile east southeast of the Bass River (Mass.) Light Station. Her removal has been authorized, and will be accomplished during the early part of the next fiscal year.

5. Barge Excelsior.—This barge was wrecked during March, 1898, and is reported sunk on Killpond Bar, some 2 miles southeast of the Bass River (Mass.) Light Station. Removal of this barge has been authorized and will be accomplished early in the next fiscal year.

6. Schooner Angola.—This schooner was wrecked in May, 1898, and is reported sunk in about 50 feet of water some 1½ miles west-northwest of the Cross Rip Light-Ship in Vineyard Sound. This wreck is regarded as quite dangerous to navigation, and has been marked by a gas buoy by the Light-House Department. Her removal has been authorized and will be accomplished at an early date.

The cost of work on wrecks during the year was $813.86.

(See Appendix C 18.)

PRELIMINARY EXAMINATIONS AND SURVEY MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examinations and survey of the following localities, required by the river and harbor act of June 3, 1896, were made by the local engineer, Maj. D. W. Lockwood, Corps of Engineers, and reports thereon submitted:

1. Preliminary examination of Herring River, Harwich, Mass.—Major Lockwood submitted report of preliminary examination September 13, 1897. For reasons given he does not consider the locality worthy of improvement by the General Government, and his views are concurred in by the division engineer, Col. G. L. Gillespie, Corps of Engineers, and by the Chief of Engineers. The report was transmitted to Congress and printed in House Doc. No. 108, Fifty-fifth Congress, second session. (See also Appendix C 19.)

2. Preliminary examination of Salt Pond, Harwich, Mass.—Major Lockwood submitted report of examination September 13, 1897. For the reasons given in the report he does not deem the locality worthy of improvement by the General Government, and his views are concurred in by the division engineer, Col. G. L. Gillespie, Corps of Engineers, and by the Chief of Engineers. The report was transmitted to Congress and printed in House Doc. No. 121, Fifty-fifth Congress, second session. (See also Appendix C 20.)

3. Survey of inner harbor at Point Judith Pond, Rhode Island.—Major Lockwood submitted report of survey August 12, 1897. The plan of improvement presented provides for securing an entrance 300 feet wide with a central depth of 8 feet into the pond and the dredging of a channel of the same depth for a distance of 1 mile to reach the 8 foot depth in the pond. The cost, including that of bridging at Great Island, is estimated at $473,490, and the cost of maintaining an entrance into the pond is uncertain.

To reach the towns north of the pond would require the dredging of

the small stream on which they are located, and Major Lockwood states that this work would be very expensive, as the dredged material would in all probability have to be dumped into the ocean or near the south end of the pond. The surveys heretofore made have not been sufficiently in detail to warrant a proper estimate being made for improvement north of the pond, and, in the opinion of the local officer, a survey should include the whole pond and the stream emptying into it from the north. He also states that the upper part of the pond will freeze over in even ordinarily severe winters, so that continuous navigation, leaving out of consideration the violent storms to which the locality is subject, can not be assured.

It is Major Lockwood's opinion that the locality is not worthy of improvement, as the cost would be entirely out of proportion to the benefits to be conferred, and that the interests are local rather than national. His views are concurred in by the division engineer, Col. G. L. Gillespie, Corps of Engineers.

The report was transmitted to Congress and printed in House Doc. No. 132, Fifty-fifth Congress, second session. (See also Appendix C 21.)

IMPROVEMENT OF RIVERS AND HARBORS IN CONNECTICUT, OF PAWCATUCK RIVER, RHODE ISLAND AND CONNECTICUT, AND OF CONNECTICUT RIVER, MASSACHUSETTS AND CONNECTICUT.

This district was in the charge of Maj. Smith S. Leach, Corps of Engineers, having under his immediate orders Lieut. William J. Barden, Corps of Engineers, to March 13 and since April 16, 1898. Division Engineer, Brig. Gen. G. L. Gillespie, U. S. Volunteers, colonel, Corps of Engineers.

1. Pawcatuck River, Rhode Island and Connecticut.—The navigable part of the Pawcatuck River extends 5 miles from the town of Westerly, R. I., to its outlet in Little Narragansett Bay; thence the navigable channel extends through Little Narragansett Bay 2½ miles to Stonington outer harbor, which forms the approach to the bay and river. Little Narragansett Bay is about 1½ miles wide and 2½ miles long, and is separated from the ocean by a sand beach joining Watch Hill and Napatree Point and another west of the point. Its outlet into Stonington Harbor is about three-fifths of a mile wide. Pawcatuck River has a width of about one third of a mile at its mouth, and diminishes to 200 feet at Westerly; its average width is 1,000 feet. The object of the improvement is to deepen and widen the channel of the river and Little Narragansett Bay from Westerly to Stonington Harbor, a total distance of 7½ miles. The improvement previous to 1884 was carried on under two projects, one for Pawcatuck River and the other for Little Narragansett Bay, but now it is all included in the project for improvement of Pawcatuck River. (For maps see Report Chief of Engineers, 1879, p. 314; p. 624 of 1885, and House Doc. No. 62, Fifty-fourth Congress, first session.)

Before improvement the channel of the river was crooked and obstructed by numerous shoals, on some of which there was but 1½ feet at mean low water, and 4½ feet was the greatest depth that could be carried across the shoals of the bay. The mean tidal oscillation is 2.6 feet at the mouth of the river and 2.3 feet at Westerly. Between 1871 and 1876 $50,000 was appropriated for the excavation of a channel in the river 5½ feet deep at mean low water, 75 feet wide below the wharves, and from 35 to 40 feet wide between the upper and lower wharves at Westerly. Between 1876 and 1883 $36,000 was appropriated for making a channel through the bay 200 feet wide and 7½ feet deep at mean low water by dredging and the removal of rocks from the bay, and

between 1885 and 1895 $48,400 was appropriated for increasing the depth and width in the river to a low-water depth of 8 feet with width of 100 feet below the wharves and 40 feet opposite the wharves at Westerly. The three projects have been completed as designed—the first in 1876, the second in 1884, and the third in 1895.

The present approved project, that of 1895, based on the report of the survey ordered in the river and harbor act of August 18, 1894, provides for a channel of 10 feet depth at mean low water from Stonington to Westerly, with a width of 200 feet from Stonington, Conn., to Avondale, R. I., a distance of about 4 miles; a width of 100 feet from Avondale to the lower wharves of Westerly, a distance of about 3 miles; and a width of 40 feet between the upper and lower wharves at Westerly, a distance of about one-half mile, at a total estimated cost of $200,361.60.

The sum of $135,970.96 had been expended up to June 30, 1897, by which the 8-foot channel had been completed under previous projects from Stonington to Westerly, and work under the new 10-foot project had just been commenced.

During the fiscal year ending June 30, 1898, the 40-foot channel opposite the wharves at Westerly and 1,800 linear feet of the 100-foot channel below the wharves have been completed to the projected depth of 10 feet by the removal of ledge rock and bowlders and dredging. No work having been done at the lower end under the new project, 8 feet at mean low water was the maximum draft that could be carried from Stonington to Westerly at the close of work, and it is believed that no shoaling has occurred since that time.

The effects of the improvement are the use of a larger class of vessels than formerly, larger cargoes, and cheaper freights on them.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
	No.	Draft.	Tonnage.	Received and shipped.	Compared with preceding report. Increase.	Compared with preceding report. Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1890	1,285	2 to 8	3 to 300	28,667	.....	.....
1893	2,045	5 to 10	3 to 300	35,968	7,301	.....
1894	1,774	5 to 10	3 to 300	52,805	16,837	.....
1895	1,824	2 to 10	3 to 800	43,671	.....	9,134
1896	5,009	2 to 10	3 to 800	39,086	.....	4,585
1897	5,008	2 to 10	3 to 800	46,024	6,938	.....

The reported value of this commerce for 1895 (the last report of value received) was $382,213.

No new lines of transportation have been established during the year.

July 1, 1897, balance unexpended	$13,029.05
June 30, 1898, amount expended during fiscal year	12,586.18
July 1, 1898, balance unexpended	442.87

Amount (estimated) required for completion of existing project	185,361.60
Amount that can be profitably expended in fiscal year ending June 30, 1900	15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix D 1.)

2. *Harbor of refuge at Stonington, Conn.*—Stonington Harbor lies on the north side of the eastern entrance from the ocean into Long Island Sound, and its breakwaters are for the purpose of making the harbor of refuge for vessels entering and leaving this entrance. Stonington Harbor originally was an open bay, unprotected from southerly storms

and obstructed by a shoal having a low-water depth of about 6 feet at the shoalest part. The mean tidal oscillation is 2.7 feet. (For maps see Report Chief of Engineers, 1882, p. 598, p. 632 of 1884, p. 848 of 1893, and for further information p. 585 of 1881.) Between 1827 and 1831 about $37,000 was spent in constructing piers or breakwaters in the inner harbor for the protection of the general anchorage. (Annual Report, Chief of Engineers, 1879, p. 326.) In 1871 a survey of the harbor was provided for, and in 1873 an appropriation was made for dredging the harbor to 12 feet depth, this work being finished in 1875. (Annual Report, Chief of Engineers, 1874, Part II, p. 246.) Between 1875 and 1879 $102,500 was appropriated for the construction of a western breakwater about 2,000 feet long, extending to 18 feet depth of water, and for dredging the harbor to 12 feet depth inside this breakwater, this work being completed in 1880.

The approved project of 1880 provides for the construction of an eastern breakwater as a protection to the outer harbor, this breakwater, about half a mile long, to extend from the vicinity of Bartletts Reef to the vicinity of the Middle Ground Shoal, or until it gives sufficient protection to the harbor against southerly winds, all at a total cost (estimated in 1884) of from $143,000 to $191,000, according to length. This did not include the cost of a light-house foundation on the western end of the structure. The positions of the ends of this breakwater have not been definitely determined.

At the adoption of the present project, that of 1880, the outer harbor had no eastern breakwater.

To June 30, 1897, $146,364.62 had been expended on the present project, with its subsequent additions, completing 2,900 linear feet of the eastern breakwater, at a cost of $143,011.85, and under an addition to the project in 1884 a cut across Noyes Shoal, 160 feet wide and 17 feet deep at mean low water, had cost $4,187.22, and under an addition to the project in 1896 a dike or water break around Stonington Point had cost $3,352.77. The sum of $184,408.83 had been expended on previous projects, including the western breakwater and dredging at the entrance of the harbor, making the aggregate expended to that date under projects for Stonington Harbor $334,960.67. The deepening of the harbor has brought about a large increase in commerce, and the construction of breakwaters affords a harbor of refuge for vessels of all kinds in the inner and outer harbors which is extensively used as such. The maximum draft that could be carried to the docks, at time of last survey, in 1895, was the project depth of 12 feet at mean low water, and as far as known that depth still exists.

During the fiscal year a light was maintained on uncompleted breakwater. Nothing in furtherance of the project was done.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1891	6,300	2½ to 12	4 to 1,500	274,014	.....	.....
1892	4,018	3 to 12	30 to 1,500	300,000	25,986	.....
1893	3,201	3 to 12	30 to 1,500	305,750	5,750	.....
1894	3,201	3 to 12	30 to 1,500	299,870	.....	5,880
1895	3,950	3 to 12	20 to 1,500	322,814	22,944	.....
1896[a]	4,265	2½ to 12	7 to 1,500	349,650	26,836	.....

[a] *Last report received.*

The reported value of this commerce for 1895 (the last report of value received) was $45,810,830.

No new lines of transportation have been established during the year.

July 1, 1897, balance unexpended	$2,493.16
June 30, 1898, amount expended during fiscal year	948.71
July 1, 1898, balance unexpended	1,544.45

(See Appendix D 2.)

3. Mystic River, Connecticut.—Mystic River is a narrow tidal stream in the eastern part of the State of Connecticut. The navigable part of the river extends in a general northeasterly direction for nearly 4 miles from Fishers Island Sound, past the villages of Noank, West Mystic, and Mystic, above which places it receives the discharge of several small fresh-water streams. The village of Mystic lies on both the east and west banks of the river, about 3 miles above Fishers Island Sound. At this point the river is crossed by a highway bridge with a draw. Nearly a half mile farther down is the drawbridge of the New York, New Haven and Hartford Railroad.

Directly opposite the mouth of the river lie Mystic, or Ram, Island and Ram Island Shoal, which cause the channel to divide and branch off sharply to the northeast and southwest. The northeast channel is 18 feet or more in depth and of sufficient width, but crooked; it is the one used by large vessels. The southwest channel opens out into a broad flat, with about 12 feet available depth.

The river channel up to within a half mile below the highway bridge had a natural low-water depth of 15 feet or more, shoaling to about 10½ feet near the bridge, where the channel was very narrow. Its width in the lower part (from 80 to 300 feet) was sufficient, but there were several bends in its course, which made it somewhat difficult of navigation. A sketch of Mystic River was printed in the Annual Report of the Chief of Engineers for 1893, page 898.

The mean rise of tide is 2½ feet.

Under act of Congress of August 11, 1888, a preliminary examination of Mystic River was made. In the report on this examination (Annual Report of the Chief of Engineers for 1889, Part I, p. 746) a project was submitted for dredging a channel 15 feet deep at mean low water and 100 feet wide, and for reducing five bends in the channel, at an estimated cost of $30,000.

This project was adopted under the river and harbor act of September 19, 1890, appropriating funds for beginning work.

In the conduct of the work of dredging in this river, a rock having over it a least depth of about 9 feet has been uncovered near Morgan Point, and, as it lies within the limits of the proposed channel, it should be removed to a depth of 16 feet, for the safety of navigation. The project for this improvement has therefore been enlarged to provide for the removal of this rock to the depth stated, and the estimated cost of work required to complete the project has been increased $6,600 to permit the removal of this serious obstruction to commerce.

Up to July 1, 1897, 139,634 cubic yards of sand and mud had been dredged. The channel of 15 feet depth and 100 feet width had been extended to the highway bridge at Mystic, the two upper of the bends had been widened as proposed, and the lower one partly as proposed. No work had been done upon the third or fourth bend. Expenditures to the same date had been $23,731.79. During the past fiscal year, under the appropriation of 1896, the fifth or lower bend was widened 50 feet for a length of 1,200 feet. The work done has rendered the

navigation of the river somewhat easier. The channel is now completed as designed, from the highway bridge at Mystic down to and including the second bend, 1¼ miles, being 15 feet deep at mean low water and 100 feet wide, with greater widths, up to 300 feet at the bends. No work has yet been done at the third and fourth bends, opposite Sixpenny Island, and the 15-foot channel there is from 125 to 300 feet wide. At the fifth or lower bend, which is opposite the shipyard, near the mouth of the river, the 15-foot channel is from 150 to 300 feet wide. The ledge rock occurs at the sharpest part of the lower bend and in the northeast side of the channel, and has a least depth (observed) of 8.8 feet. It covers an area of about 40 by 60 feet and has been marked by a dolphin of piles. The width of the channel at this point is 160 feet. The project is advanced fully in the proportion of the aggregate appropriated to the original estimates, and should be completed without exceeding the latter. At the close of the fiscal year the maximum draft over the improvement was 15 feet at mean low water. Commerce consists of local supplies, shipbuilding materials, etc.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1891	194	7 to 12	20 to 300	31,998	.....	.....
1893 *a*	.....	.....	.....	.....	.....	.....
1894 *a*	.....	.....	.....	.....	.....	.....
1895	418	5 to 16	100 to 600	23,050	.....	*b* 8,948
1896	344	5 to 16	100 to 600	25,880	2,830	.....
1897	300	5 to 16	100 to 600	21,567	.....	4,313

a Statistics not received.
b The decrease is owing to stoppage of work at Masons Island stone quarry.

The reported value of this commerce for 1897 was $255,227.

No new lines of transportation have been established during the year.

The above does not include the business at Palmer's shipyard, at mouth of river (amounting to about 50,000 tons), which may be found in district officer's report.

July 1, 1897, balance unexpended	$3,268.21
June 30, 1898, amount expended during fiscal year	2,921.32
July 1, 1898, balance unexpended	346.89
Amount (estimated) required for completion of existing project	9,600.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	9,600.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix D 3.)

4. Thames River, Connecticut.—This river is a tidal stream formed by the confluence of two small streams at Norwich, Conn., which is the head of navigation, and extends thence to Long Island Sound, a distance of 15 miles. For 11 miles above its mouth the river has a natural channel of 13 to 80 feet depth, but for the upper 4 miles the available depth was originally but 6 feet at mean low water. The tidal oscillation is 3.1 feet at Norwich and 2.5 feet at the mouth. The lower stretch of the river forms the harbor of New London. A railroad bridge with a draw of 500 feet clear span crosses the river just above New London. This bridge has two clear openings of 205 feet each.

Histories of the improvement of this river near Norwich may be found in the Annual Report of the Chief of Engineers for 1873, page 981, and in that for 1879, Part I, page 331, and further information in relation to present project in report for 1895, pages 760–761. Shaws Cove, New London Harbor, is a cove on the west side of Thames River, about 2 miles above its mouth, and constitutes the southern water front of the business portion of the city of New London. It is separated from the river by the embankment and trestle of the New York, New Haven and Hartford Railroad, having a draw of 55 feet width. The natural depth in Shaws Cove was from 2½ to 8 feet at mean low water in a narrow and crooked channel bordered by flats. The latest published maps of the river will be found in the Report of the Chief of Engineers for 1894, page 628, and of Shaws Cove, 1893, page 904. Harbor lines were established in Shaws Cove in 1893.

Under an appropriation made in 1836 a project was adopted for making a channel 14 feet deep at high water (11 feet at low water) by dredging and by building dikes, at an estimated cost of $72,650. Work was stopped in 1839 by exhaustion of appropriations before the project was completed.

Under an appropriation made in 1866 a project was adopted for dredging to make a channel of 11 feet depth at mean low water. This was modified in 1879 to make the depth 14 feet at mean low water, and in 1882 training walls were projected to maintain the channel, the width of which was placed at 200 feet. In compliance with the river and harbor acts of 1888 and 1892, the project was extended to provide for a depth of 16 feet up to Allyn Point, 5 miles below Norwich, and for a channel 100 feet wide, with an anchorage basin adjacent, in Shaws Cove, New London, where the depth was to be 12 feet.

The present project therefore consists in making and maintaining by dredging and a system of training walls a channel 200 feet wide from New London to Norwich, to be 16 feet deep at mean low water to Allyn Point, and thence to Norwich to be 14 feet deep, together with dredging in Shaws Cove, New London, to make a channel 100 feet wide and 12 feet deep and an anchorage basin of the same depth and of about 7½ acres area. The estimated cost from the beginning is $457,600. The estimated cost of maintaining the channel is, approximately, $8,000 per year.

Up to June 30, 1897, $376,475.34 had been expended under the present project. Three of the five proposed training walls had been completed, and the fourth nearly so. The proposed river channel was completed to Allyn Point; thence to a point just below Norwich it had been made the full depth of 14 feet, with widths from 175 to 100 feet. The 12-foot channel in Shaws Cove had been completed, and the anchorage basin had been half finished.

During the past fiscal year, under appropriation of 1896, the 14-foot channel was extended 1,200 feet, or to the deep water at the Norwich docks, with a width of 100 feet, and it was widened from 25 to 50 feet for a length of a mile below the New York and New England Railroad Dock at Norwich. At the close of work in September, 1897, the 14-foot channel had been carried from Allyn Point to Norwich, with widths of from 100 to 175 feet, and as far as known the same depth now exists. No shoaling has been reported in the 16-foot channel to Allyn Point, and the depth of the dredging in Shaws Cove is still as above stated.

Commerce at Norwich and Allyn Point consists mainly of coal, lumber and other building materials, iron, and miscellaneous goods. The work done has reduced the cost of transportation by enabling freight to

be brought in vessels of 14 feet draft instead of 8 feet. The river commerce of the present day could not have been carried without the increased depth.

Commerce in Shaws Cove consists mainly of lumber and coal. Fishing steamers and pleasure boats use the cove for wintering and for fitting out in the spring. The work done has added materially to the convenience of this navigation, but has not noticeably affected its amount.

Table of comparative statistics.

[Including Shaws Cove, New London Harbor.]

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1890	810	4 to 16	100 to 1,500	467,144	.....	.....
1891	219	4 to 16	100 to 1,500	609,568	142,424	.....
1893	1,906	4 to 16	100 to 1,600	546,900	.....	62,668
1894 a	1,217	4 to 16	100 to 1,600	.....	.....	.....
1896	1,844	5 to 19	100 to 1,900	424,945	.....	121,955
1897	1,762	5 to 19	100 to 1,900	374,724	.....	50,221

a Tonnage not received.

The reported value of this commerce for 1893 (the last report of value received) was $25,000,000.

No new lines of transportation have been established during the year.

July 1, 1897, balance unexpended	$12,024.66
June 30, 1898, amount expended during fiscal year	9,958.85
July 1, 1898, balance unexpended	2,065.81

Amount (estimated) required for completion of existing project	69,100.00
Amount (estimated) required for maintenance annually	8,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, including maintenance	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix D 4.)

5. *Connecticut River below Hartford, Conn.*—The Connecticut River below Hartford is a large stream. For the first 21 miles it flows in a winding course, mostly through alluvial meadows, which are overflowed at high water, and which consist of a light, sandy soil, easily undermined. For the remaining 29 miles to Long Island Sound, at Saybrook Point, the course is straighter, the banks more permanent, and generally harder. A gauge has been established at Hartford whose zero is the lowest stage that the water is known to have reached from natural causes. Closing the gates at the Holyoke Dam in time of drought has caused the water to fall lower.

The usual low-water stage of the river in the summer is about 1 foot on this gauge. Spring freshets ordinarily rise to 20 feet; the highest recorded stage of water is 29 feet.

The average tide at Saybrook is 3½ feet; at Hartford it is 1 foot, though when the water stands above 5 feet on the Hartford gauge the tide there is not perceptible. The low-water slope of the river from Hartford to Saybrook averages 0.0458 foot per mile. The bed of the river through the alluvial meadows within 10 miles of Hartford is constantly changing from the undermining of the banks. It is said that in places it has changed its position a half mile. The bars in this part

of the river, after being dredged, form again during freshets and ice jams, so that some of them require to be dredged annually, others less frequently. This part of the river was worked upon by corporations and by private parties at various times between 1800 and 1870. Several small stone piers to deepen the channel at shoal places were built in this way. Some of these are covered by new banks, the channel has shifted to the opposite side of others, and others still have been dredged out because they had come to be obstructions. The depth sought by these works was 6 feet at low water.

Before the beginning of improvements by the United States the available depth over Saybrook Bar was 7 feet at mean low water; thence to Hartford the available depth over the shoalest of the river bars was about 5 feet at low water, being generally at its minimum after the spring freshets, and increasing as the period of summer low water continued.

By act of July 4, 1836, Congress appropriated $20,000 "for improving the harbor at Saybrook by removing the bar at the mouth of the Connecticut River." A survey was made and a plan submitted for dredging a cut 500 feet wide and 12 feet deep at mean low water, at an estimated cost of $54,380.50. A channel was dredged 1,500 feet long, 50 feet wide, and from 11 to 12 feet deep in 1840; it almost completely filled up during the storms and freshets of the following winter and spring. No further appropriation was made for this project except to pay a balance due the contractors. By act of March 2, 1867, Congress ordered a survey of the Connecticut River, which was made that year, and which embraced the principal bars and obstructions between Hartford and Long Island Sound. The report upon this survey, printed in the Annual Report of the Chief of Engineers for 1868, page 754, presented a plan for improving the river below Hartford by dredging to make a channel 8 feet deep at low water and 100 feet wide in the river; 8½ feet deep and 200 feet wide at Saybrook Bar, at the mouth of the river; protecting the shore at Hartford and Wethersfield by piling, and removing Chester Rock, at a total estimated cost of $70,000, with an estimate of $10,000 as the annual cost of maintaining these channels. This project was adopted under authority of the river and harbor act of 1870, which made an appropriation for beginning the work.

In 1873 a project was adopted for improving the channel at Saybrook Bar, at the mouth of the river, by dredging and by building three jetties, at an estimated cost of $336,610. Two of the proposed jetties were completed in 1881, and the third was found to be unnecessary.

In 1880 a plan was adopted for permanent improvements at the worst six bars in the river by riprap wing dams or dikes, mattresses, shore protection, and rectification of the banks, at an estimated cost of $330,487. Dikes at Hartford and Glastonbury bars were built. In 1887, when it had become evident that these constructions would not sufficiently reduce the amount of dredging required each year, the plan was abandoned, and the project of 1870 for annual dredging was reverted to, modified to provide for a depth of 9 feet at extreme low water, together with estimates for completing the Saybrook jetties and dredging between them to 12 feet depth at an estimated cost of $80,000. This was modified in 1889 to include raising the Hartford Dike to 15 feet above low water, at an estimated cost of $50,000.

The present project is therefore the project of 1870, modified to provide for a channel from Long Island Sound to Hartford, Conn., to be 400 feet wide and 12 feet deep at mean low water across Saybrook Bar, and thence to Hartford to be 100 feet wide (or as nearly that as practicable) and 9 feet deep at extreme low water, or about 10 feet at ordinary summer low tide, the channels to be maintained by annual dredging in the

river and by enlarging the Saybrook jetties and the Hartford Dike at an estimated cost—

For annual dredging	$10,000
For permanent work, which includes the dredging at Saybrook Bar (estimated in 1889)	130,000

The maintenance of navigable channels by annual dredging has been held paramount in the project, and is the only work of improvement done upon this river since 1887, the available funds at no time having been sufficient for enlarging the dike or Saybrook jetties or for additional dredging at Saybrook Bar. The jetties are constantly deteriorating, and are now in a condition demanding attention.

The total amount expended by the United States for this improvement from 1836 to June 30, 1897, was $456,245.61.

July 1, 1897, annual dredging was in progress to remove the shoals which had formed during the freshets of the preceding spring. Dredging was resumed near the close of the fiscal year to clear the channels after this year's flood, and is in progress at the date of this report. The annual dredging will usually be between May 20 and August 15.

Sketches of the Connecticut River from Hartford to Rocky Hill and of Saybrook Bar were printed in the Annual Report of the Chief of Engineers for 1885, page 636. The river from the sound to Hartford is shown on Coast Survey charts 253, 254, 255, and 256.

Commerce consists mainly of coal, stone (shipped from Portland and vicinity), building materials, and miscellaneous freight.

The work done and being done has reduced freights on these articles materially, and without the improvements there could be little commerce on the river.

The maximum draft that can be carried June 30, 1898, at extreme low water over the shoalest part of the river under improvement is 9 feet.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1890	.....	7 to 12	100 to 600	1,095,000	.....	.....
1893	1,200	7 to 12	100 to 1,000	650,000	.....	445,000
1894	1,130	7 to 12	100 to 1,000	560,000	.....	90,000
1895	1,300	7 to 12	100 to 1,600	712,000	152,000	.....
1896	1,300	6 to 12	100 to 1,600	772,000	60,000	.....
1897	1,350	6 to 12	100 to 1,600	810,000	38,000	.....

The reported value of this commerce for 1897 was $45,500,000.

No new lines of transportation have been established during the year.

July 1, 1897, balance unexpended		$19,924.39
June 30, 1898, amount expended during fiscal year		10,395.32
July 1, 1898, balance unexpended		9,529.07
July 1, 1898, outstanding liabilities	$2,542.33	
July 1, 1898, amount covered by uncompleted contracts	5,257.67	
		7,800.00
July 1, 1898, balance available		1,729.07
Amount (estimated) required for completion of existing project		130,000.00
Amount (estimated) required for maintenance annually		10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, including maintenance		20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix D 5.)

6. Harbor of refuge at Duck Island Harbor, Connecticut.—Duck Island Harbor is a bay on the north shore of Long Island Sound. It is about 7 miles west of the mouth of the Connecticut River and midway between the harbors of New Haven and New London. In this distance of 46 miles there is no harbor of sufficient size and depth to shelter any considerable part of the general commerce of the sound. Duck Island Harbor has a large anchorage area, with depths of 16 feet or more at low tide, and with good holding bottom. It is sheltered from the north by the mainland, partly sheltered from the east by Menunketesuck Point, and slightly sheltered from the south by Duck Island, an island about 900 feet long (north and south) by 300 feet wide, situated in the mouth of the harbor, rather more than half a mile west-southwest from Menunketesuck Point. The mean tidal oscillation is 3.80 feet.

The project for this improvement, adopted by the river and harbor act of 1890, provides for the construction of three riprap breakwaters of 3,000, 1,750, and 1,130 feet length, respectively, inclosing and sheltering an area of about 115 acres, with two ample entrances. The adopted grade is 6 feet above high water, with crown of 10 feet and slopes of 2 on 3 outside and 1 on 1 inside. The estimated aggregate cost is $463,540. For map see Report of Chief of Engineers, 1887, page 644.

Work under this project was begun in May, 1891, and up to June 30, 1897, $91,673.45 had been expended, and 2,385 linear feet of the west breakwater had been built, extending westwardly from Duck Island to a low-water depth of 17 feet. At the beginning of the year a contract was in force for work under the appropriation of $24,000, act of June 3, 1896, but the contractor failed to commence work, and the contract expired by limitation on August 27. The work was relet, and a contract made on November 6 for extending and enlarging the breakwater westerly from Duck Island. Work was begun on November 8, and continued throughout the remainder of the year, and up to the close of the year 20,935 tons of riprap was placed in the work, extending it 370 linear feet, and repairing 380 linear feet on outer end of work built under previous contract. The contract will be completed by August 1, 1898. A light was maintained at end of the uncompleted structure during the year.

The breakwater now affords a limited shelter from south and southeast storms, and is to some extent sought for that purpose.

The commerce to be benefited by this improvement is the passing commerce of Long Island Sound, which may find it convenient or necessary to seek shelter behind the breakwater during storms. Its value can not be estimated with any accuracy.

A record kept by the light keeper showed that 188 vessels had been anchored behind the breakwater during the year ending July 1, 1897.

No report has been received for this year.

July 1, 1897, balance unexpended		$22,326.55
June 30, 1898, amount expended during fiscal year		15,434.78
July 1, 1898, balance unexpended		6,891.77
July 1, 1898, outstanding liabilities	$3,423.28	
July 1, 1898, amount covered by uncompleted contracts	2,883.65	
		6,306.93
Jul 1, 1898, balance available		584.84

Amount (estimated) required for completion of existing project	349,540.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix D 6.)

7. *New Haven Harbor, Connecticut.*—New Haven Harbor is a bay on the north shore of Long Island Sound, extending about 4 miles inland and from 1 to 2 miles wide. The Mill and Quinnipiac rivers empty into the head of the harbor from the northeast. They are navigable for about 1 and 3 miles, respectively, above their mouths. The mean range of tides is 6.1 feet.

The harbor channel is from 400 feet to a mile wide, with mud and sand flats on either side. When the Government began work in this harbor in 1867 the available low-water depth from the wharves to Cranes Bar, one-third way down the harbor, was 9 feet; thence to Fort Hale, halfway down, it was 16 feet or over. Just below Fort Hale was a broad shoal of very soft mud extending across the channel, with 13 feet available depth at mean low water. The harbor entrance was partly obstructed by several sunken rocks.

Several plans for removing certain of the rocks at the harbor entrance have been proposed, and work upon two of them was begun. Before they were completed the light-house was removed to Southwest Ledge, and the project for breakwater construction at the harbor entrance was adopted, using these rock shoals as a base and making their removal unnecessary.

Under the appropriation of 1871 the project was extended to include dredging a channel in the harbor. This was at first designed to be 13 feet deep at mean low water and 200 feet wide. When appropriations were made beyond what was required for completion of the project it was from time to time extended, and now consists in making a channel 16 feet deep at mean low water and from 400 to 700 feet wide from Tomlinson's bridge, at the head of the harbor, to Long Island Sound, by dredging and construction of a dike to contract the channel width over Fort Hale Bar, at an estimated cost from beginning of $348,000. Details concerning the several extensions of the project were printed in the Annual Report for 1895, page 777.

For maps see Annual Report, Chief of Engineers, 1889, page 678, page 702 of Report for 1896, and House Doc. No. 82, Fifty-fifth Congress, first session.

Harbor lines for New Haven Harbor were established by the Secretary of War November 17, 1894, and were slightly modified and amended by him March 2, 1895, and May 20, 1895.

The total amount expended to June 30, 1897, was $316,773.14, at which date a dike had been built from Sandy Point to contract the channel width on Fort Hale Bar, the length of its channel arm, 2,089 feet, being about two-thirds the projected length; the channel up to the wharves had been made 16 feet deep at mean low water, and from 400 to 700 feet wide, except across Fort Hale Bar, where the width was but 100 feet.

During the past fiscal year the dredged channel over Fort Hale Bar, 6,560 feet long, was increased to 200 feet width.

Under the existing project there remains only the widening of the channel over Fort Hale Bar by dredging, and the extension of the dike, if necessary. A resurvey of the harbor was made in July and August, 1896, and a revised project presented to Congress and printed as House Doc. 82, Fifty-fifth Congress, first session. The revised project, if adopted, will involve dredging to greater depth and over somewhat greater areas.

On June 30, 1898, the maximum draft that could be carried over the shoalest part of the improvement, which is in the upper part of the harbor, was 14 feet at mean low water. The Fort Hale Channel still

retains 16 feet depth, but has narrowed 25 to 50 feet by caving in of the side banks.

The commerce of New Haven consists mainly of coal, iron, lumber, and miscellaneous freights. The increased depth resulting from the improvement has facilitated the transportation of these freights and lessened the delay for tides. A large part of the present commerce could not have been carried on without the improved channel.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1880	18,845	6 to 18	100 to 1,000	2,205,813	.....	.....
1890	18,025	6 to 20	100 to 1,200	2,980,400	774,587	.....
1892	29,093	6 to 20	100 to 1,800	3,143,000	162,600	.....
1894	29,860	6 to 22	100 to 2,500	3,184,000	41,000	.....
1895	31,400	6 to 22	100 to 2,600	3,295,900	111,900	.....
1896	28,650	6 to 22	100 to 2,600	3,052,000	.....	243,900

The reported value of this commerce for 1896 was $250,195,000.

No new lines of transportation have been established during the year. Statistics for 1897 have not been received.

July 1, 1897, balance unexpended	$9,226.86
June 30, 1898, amount expended during fiscal year	8,663.98
July 1, 1898, balance unexpended	562.88

Amount (estimated) required for completion of existing project	28,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	28,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix D 7.)

8. *Breakwaters at New Haven, Conn.*—New Haven is the only natural harbor of any considerable area and depth in Long Island Sound between New London Harbor, 45 miles east, and Huntington Bay, 32 miles southwest. At this point Long Island Sound is at its widest, and the broad, open mouth of the harbor left the anchorage grounds exposed to storms from a southerly quarter, so that vessels driven in by stress of weather were frequently obliged to cross Fort Hale Bar, going from 2 to 4 miles up the harbor, and to anchor in the dredged channel in order to reach secure shelter. The mean rise of tide is 6.1 feet.

January 21, 1875, a resolution of the House of Representatives called "for a report from surveys already made in regard to the expediency and estimate of expense of a breakwater between the eastern shore of the entrance to said harbor [New Haven Harbor] and Southwest Ledge, so called, or such part of said distance as may be found most expedient or necessary for the protection of said harbor." In reply to this resolution a report was made January 27, 1875 (printed in the Annual Report of the Chief of Engineers for 1875, Part II, p. 251), with estimates for three different locations for the breakwater.

The river and harbor act of 1879 appropriated $30,000 for the "construction of a breakwater at New Haven, Conn." The several plans were referred to The Board of Engineers, whose report (printed in the Annual Report of the Chief of Engineers for 1880, p. 449) recommended two riprap breakwaters, each to be 12 feet wide on top, the top being

6 feet above mean high water, one to extend from Southwest Ledge to Quixes Ledge, a distance of 3,300 feet, and one 4,200 feet long, extending northwest and southeast and overlying Luddington Rock, the whole estimated to cost $1,311,134. This project was adopted, and under it the east breakwater was built.

The river and harbor act of 1888 authorized the relocation of the western breakwater, and a modification of the project was submitted in the Annual Report of 1889. The river and harbor act of 1890 appropriated $120,000 for "constructing breakwater at New Haven, Conn., in accordance with plans submitted by the Chief of Engineers in the report for 1889, page 678." The project for this work, thus modified, consists of making a harbor of refuge at the entrance to New Haven Harbor by constructing four breakwaters, one extending from Southwest Ledge to Quixes Ledge; one 5,000 feet long, extending from a point 1,000 feet north 54 degrees east from Luddington Rock, southwesterly across the rock; one about 4,200 feet long, extending northwesterly from a point 6,000 feet south 54 degrees west from Luddington Rock, and one about 1,200 feet long, extending southwesterly from Morgan Point on the east side of the harbor entrance. The estimated cost of the whole work from the beginning in 1879 was $2,151,134.

The anchorage outside of the bar which will be sheltered by this breakwater exceeds 2,000 acres, and has depth of 9 to 26 feet at mean low water.

A sketch of New Haven Harbor, showing the location of the breakwaters as contemplated under the existing project, was printed in the Annual Report of the Chief of Engineers for 1889, page 678, and the last printed sketch may be found in Annual Report for 1896, page 702.

Up to July 1, 1897, the breakwater from Southwest Ledge to Quixes Ledge had been completed, and the Luddington Rock breakwater had been made 4,500 feet long, and 1,490 feet of the west breakwater had been built. The total expenditures to this date had been $830,876.31.

During the past fiscal year lights were maintained on the Luddington Rock and west breakwaters. Nothing in furtherance of the project was done.

The commerce benefited by this work is the passing commerce of Long Island Sound. During 1895, 151,356 vessels were observed passing the breakwaters, and 3,925 vessels were observed at anchor in the mouth of the harbor, where they were partly under their shelter.

No estimate of the value of this commerce can be made.

July 1, 1897, balance unexpended	$4,123.69
June 30, 1898, amount expended during fiscal year	1,585.48
July 1, 1898, balance unexpended	2,538.21
July 1, 1898, outstanding liabilities	125.00
July 1, 1898, balance available	2,413.21
Amount (estimated) required for completion of existing project	1,316,134.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix D 8.)

9. Housatonic River, Connecticut.—The Housatonic is a long, shallow river running southward through Massachusetts and Connecticut, emptying into Long Island Sound just east of Stratford Point, about 15 miles southwest from New Haven. At Derby, 13 miles above its mouth,

it receives the discharge of the Naugatuck, a small, rapid river. This point, which has been regarded as the head of navigation, is nearly at the head of tide water. About a mile above there is a dam across the Housatonic River furnishing large water power. For at least 5 miles below Derby the water is always fresh.

The original depth on the worst bars in the river (six in number) was from 3.5 to 4.5 feet at mean low water; there was also a bar across the river's mouth with about 4 feet low-water depth. The mean rise of tide at Derby is 4.2 feet; at the mouth of the river it is about 6.2 feet.

By act of Congress of July 11, 1870, a survey of the Housatonic River was ordered. The report on the survey, printed in the Annual Report of the Chief of Engineers for 1871, page 781, presented estimates for making a channel 7 feet deep at mean low water, to be 200 feet wide over the bar at the mouth of the river and 150 feet wide in the river, by dredging, removing Drews Rock, and building a jetty at Sow and Pigs Reef, the channel at the mouth to be protected on the east side by a breakwater. The estimated cost was $404,961, of which $368,475 was the estimated cost of the breakwater.

This project was adopted under the river and harbor act of 1871, which made an appropriation for beginning the work. Dredging was done on the several bars in the river, the jetty at Sow and Pigs Reef was built, and under a modification of the project a jetty was built at Drews Rock. The latter, however, caused a shoal to form below the rock, and in 1888 the rock was removed, as originally proposed. Up to 1888 no work had been done upon the bar at the river's mouth. This was considered the most important work in the river, but the channel could not be permanently deepened until the breakwater was constructed, and funds sufficient for that work had not been appropriated. In 1885 and 1886 certain oyster growers who wished to use dredged material for oyster beds offered to dredge across the outer bar without expense to the United States; they removed 52,888 cubic yards of sand and shells, making a channel 70 feet wide and 9 feet deep. The first severe storm following completely filled the outer part of the channel.

In 1887 the estimates of cost were revised and the project modified, reducing the width of channel in the river to 100 feet and proposing a riprap breakwater to be built to half tide for the first 3,250 feet from shore, and thence for about 2,500 feet farther to be built to 6 feet above high water, at an estimated cost of $202,000. The reasons for this were presented in Senate Ex. Doc. No. 103, Fiftieth Congress, first session, and in the Annual Report of the Chief of Engineers for 1888, page 554. This modification of the project was adopted under the river and harbor act of 1888. In 1893 the project was further modified to provide for building a small dike below Stratford to reduce the amount of dredging required.

The present project for improvement is, therefore, the project of 1871, subsequently modified, and consists in making and maintaining a channel 7 feet deep at mean low water from Long Island Sound to the head of navigation, about 13 miles, to be 100 feet wide in the river and 200 feet wide over the bar at the mouth, by dredging, removing Drews Rock, building a jetty at Sow and Pigs Reef, and a small dike at the bend below Stratford, and protecting the channel at the mouth of the river by a breakwater about 5,750 feet long. The estimated cost, from the beginning in 1871, is $275,500.

A survey called for in the river and harbor act of June 3, 1896, was made, and a report and revised project submitted March 16, 1897. The report is published as House Doc. No. 16, Fifty-fifth Congress, first session.

For maps of the whole navigable part of the river see Annual Report of the Chief of Engineers, 1882, page 616, and House Doc. No. 16, Fifty-fifth Congress, first session; and of the mouth, Annual Report, 1886, page 642, and 1887, page 608.

July 1, 1897, Drews Rock had been removed, the jetty at Sow and Pigs Reef had been built, the dike below Stratford had been made 555 feet long, and the breakwater at the river's mouth had been made 5,821 feet long, the 3,250 feet nearest shore being built to about half-tide level, and the outer part being built 4 to 6 feet above high water. Dredging had been done on the several bars in the river and at the mouth; the former had shoaled to a depth of 4 feet, but at the mouth the channel was 8 feet deep and 150 feet wide, all at a total cost of $198,581.63. At the beginning of the past fiscal year dredging on the bars above the mouth of the river had just been begun; work was continued until October 23, 1897, at which time channels over the bars were left clean at project dimensions. On June 30, 1898, 8 feet at low water could be carried across the bar at the mouth of the river, and from 5 to 7 feet over the bars above the mouth.

The commerce consists mainly of coal, iron, building materials, oysters, and raw materials for manufacturers, and miscellaneous freight. The work done and being done has enabled vessels to enter the lower river in safety, instead of waiting for high tide in an exposed situation outside the mouth of the river; and a large part of the commerce could not have been carried on without the improved channel.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1890 *a*	15,124	1 to 8	1 to 800	138,800	.....	.....
1892 *a*	12,215	1 to 8	1 to 400	202,325	63,525	.....
1893 *a*	12,381	1 to 8	1 to 450	159,830	.....	42,495
1896 *b*	1,260	2 to 8	3 to 450	79,647	.....	80,183
1897	1,383	2 to 8	3 to 450	83,200	3,553	.....

a Includes the small vessels used in the oyster industry at mouth of river.
b No report received between 1893 and 1896.

The reported value of this commerce for 1897 was $456,600.
No new lines of transportation have been established during the year.

July 1, 1897, balance unexpended	$14,918.37
June 30, 1898, amount expended during fiscal year	13,087.87
July 1, 1898, balance unexpended	1,830.50
Amount (estimated) required for completion of existing project	62,000.00
Amount (estimated) required for maintenance annually	4,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, including maintenance	24,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix D 9.)

10. Bridgeport Harbor, Connecticut.—This harbor extends nearly 3 miles inland from the north shore of Long Island Sound, its width of about a mile at the mouth decreasing to 200 feet between the opposite wharves at its upper end. The channel in every part of the harbor is comparatively narrow, and is crossed by four drawbridges. Before the

first work was done by the United States the depth over the bars near the harbor's mouth was 5 feet at low water, and above the bridges from 2 to 5 feet.

The mean rise of tide is 6½ feet.

In 1836 Congress appropriated $10,000 for improving this harbor, and again the same amount in 1852. These sums were expended in dredging near the mouth of the harbor, making channels 60 to 100 feet wide and 8 feet deep or more at low tide. The depths made did not prove permanent. Under acts of Congress of June 23, 1866, and July 11, 1870, surveys or examinations of the harbor were made, and the report upon the latter examination proposed a plan for improvement by dredging a channel 100 feet wide and 12 feet deep at extreme low water, and protecting the outer channels by a breakwater extending about 3,000 feet from Long Beach, on the east side of the harbor entrance, all at an estimated cost of $124,000. This project was adopted in 1871, when an appropriation was made for beginning work upon it.

In 1875 the dimensions of the proposed channel were modified to make it 12 feet deep at mean low water and from 200 to 300 feet wide up to the lower or Stratford Avenue Bridge. This was accomplished in 1882, and then the project was again modified to include widening the channel between the Inner Beacon and the Naugatuck Dock, a distance of 3,800 feet, to prevent overcrowding the main channel by vessels entering for shelter, at an estimated cost of $60,000. This work has been nearly completed.

In compliance with the terms of the river and harbor acts of 1878 and 1888, the project was extended to include a channel 100 feet wide and 9 feet deep to the head of navigation at Berkshire Mills, and again, under the terms of the river and harbor act of 1890, to include a breakwater from The Tongue to the Inner Beacon. The river and harbor act of 1894 also authorized the expenditure of the appropriation made for deepening the channel at the outer bar, and the project was extended to provide for 15 feet depth at that point.

Under the authority of the river and harbor act of 1894 a survey of the harbor was made, and the report, printed in Annual Report, Chief of Engineers for 1896, Part II, pages 803–805, and also in House Doc. No. 61, Fifty-fourth Congress, first session, submitted estimates for extending the 15-foot channel to the lower bridge, making it 300 feet wide up to the Inner Beacon and 200 feet wide above that beacon, which, with the uncompleted work of the then existing project, was estimated to cost $90,000.

The river and harbor act of June 3, 1896, appropriated $28,000 for continuing the improvement in accordance with the modified project, $10,000 of which "shall be expended upon Yellow Mill Pond for constructing a channel 12 feet deep and 200 feet wide from the main channel to the causeway, conditioned upon the construction by the city of Bridgeport of a drawbridge at the causeway upon plans approved by the Secretary of War."

The adopted project is therefore the original project of 1871 thus modified and extended, and consists in making and maintaining a channel from Long Island Sound to the head of navigation at Berkshire Mills, to be 15 feet deep at mean low water and 300 feet wide to the Inner Beacon; thence to the lower bridge to be 15 feet deep and 200 feet wide, with increased width, 12 feet deep, for anchorage, and with a 12-foot channel 200 feet wide up to the causeway at the Yellow Mill Pond, the latter estimated to cost $25,000; above the lower bridge to be 9 feet deep and 100 feet wide, the channel and harbor to be protected by a breakwater from the east shore of the harbor's mouth and one from

The Tongue to the Inner Beacon, estimated to cost $115,000 in addition to amounts appropriated prior to 1895, or $385,000 from the beginning in 1871.

Harbor lines for this harbor were established by the Secretary of War July 1, 1893.

The last sketch of Bridgeport Harbor in the Annual Report of the Chief of Engineers was printed in the Report for 1893, page 940, and a complete map was published in House Doc. No. 61, Fifty-fourth Congress, first session.

The amount expended upon the present project to June 30, 1897, was $271,955.05; and at that date the channel, 12 feet deep at mean low water at the entrance, was 200 feet wide for a length of about 1,300 feet; thence to the Inner Beacon, 3,100 feet, the 12-foot channel was about 300 feet wide; and thence to Naugatuck Dock, 3,800 feet, it was 770 feet wide. From that dock to the lower or Stratford Avenue Bridge, 2,000 feet, it had shoaled so that the depth was from 10 to 11 feet. Within the limits of the 12-foot channel a part of the 15-foot channel had been dredged, which extends from the entrance to the Outer Beacon, a distance of one-half mile, and was from 60 to 100 feet in width. Above the lower bridge the channel, dredged 9 feet deep and 60 to 100 feet wide, was still nearly of that depth and width.

The breakwater at Long Beach, built in 1871–1873, had settled somewhat, but still served the purpose for which it was designed, and no repairs were needed. The breakwater from The Tongue to the Inner Beacon had been built to its full projected length with reduced cross section. It required some enlargement to make it permanent.

During the past fiscal year the 15-foot channel was extended to the Inner Beacon, making it a mile in length, and it was increased in width to 220 feet. With this addition the condition of the improvement on July 1, 1897, as stated above, represents the present condition. The maximum draft of water that can be carried through the improved channels is 10 to 15 feet to the lower bridge, and 8 to 9 feet thence to the upper end.

The commerce of this harbor consists of coal, iron, building materials, and general merchandise. The improvement already made has made it possible to use larger vessels, without which the present commerce of the harbor could not be carried on.

The important commercial interests of Bridgeport Harbor would appear to justify a modification and extension of the existing project, and the information available has permitted the preparation of such project and its estimated cost, which is available for the consideration of Congress should such consideration be deemed desirable.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1890	24,273	6 to 18	100 to 1,000	1,314,157	a 297,000	.....
1892	24,223	6 to 18	100 to 1,000	1,324,190	10,033	.....
1894	18,572	6 to 18	50 to 1,250	968,659	.....	355,531
1895	19,223	6 to 18	50 to 1,250	1,045,769	77,110	.....
1896	18,723	6 to 18	50 to 1,250	1,030,451	.....	15,318
1897	18,564	12 to 18	100 to 1,250	1,081,973	51,522	.....

a Over 1892.

The reported value of this commerce for 1897 was $55,616,356.
No new lines of transportation have been established during the year.

July 1, 1897, balance unexpended	$26,044.95
June 30, 1898, amount expended during fiscal year	15,691.96
July 1, 1898, balance unexpended	10,352.99
July 1, 1898, outstanding liabilities	100.00
July 1, 1898, balance available	10,252.99
Amount (estimated) required for completion of existing project	87,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix D 10.)

11. Saugatuck River and Westport Harbor, Connecticut.—This river is a tidal stream, the navigable part of it extending inland about 4½ miles by course of channel from Long Island Sound to Westport, Conn. It has a natural depth of 5 feet at mean low water, in a rather narrow, crooked channel, up to the railroad bridge at Saugatuck, about 3 miles from the sound; thence the depth, before improvement, decreased gradually until at Westport it was less than 1 foot. The channel was somewhat obstructed by rocks in its upper part.

For nearly 2 miles below Westport the stream is from 200 to 1,200 feet wide; below this it expands into a rather broad inner bay, with a narrow channel following the west, south, and east shores and then turning abruptly to the southeast and passing to the sound between Cedar Point on the north and Cockenoes Island on the south. On the south side of the inner bay lies Great Marsh, which is connected with Cockenoes Island by a broad sand flat, nearly bare at low tide; and east of the island a reef of bowlders extends eastward 1½ miles, so that the only entrance to the harbor at low tide is to the eastward of this reef.

The navigable part of the river is crossed by three bridges, all having draws of sufficient size for the commerce of the stream. The uppermost is a wagon bridge, at Westport; 1¼ miles below is a wagon bridge, near Saugatuck, and a quarter of a mile farther down is the bridge of the New York, New Haven and Hartford Railroad.

The mean rise of tide is about 7 feet.

Improvements of this locality have been made by the United States under the several titles of Saugatuck Harbor, Cedar Point, Westport Harbor, and Saugatuck River.

In 1826 Congress appropriated $400 for a survey of the river and harbor of Saugatuck. In the report of the survey a project was submitted for deepening the channel near Westport, removing two rocks in the river, building a breakwater on Cedar Point, and cutting a canal through Great Marsh, at a total estimated cost of $6,128.65. The project was completed nearly as designed in 1840. The breakwater at Cedar Point was made about 390 feet long, the top being 4 feet above high water and 10 feet wide, and the canal was excavated 1,350 feet long, 44 feet wide at the bottom, and 4 feet deep, and part of the east side was protected by a dry wall. The amount appropriated for and expended upon this project was $14,044.

Appropriations made in 1867 and 1870, $2,500 each, were applied to surveys and to repairing and extending the breakwater at Cedar Point.

Under the river and harbor act of 1882 a survey of the river was made, but no project for improvement was adopted.

A preliminary examination of Saugatuck River was ordered by the *river and harbor act of 1890.* A project was adopted under the appro-

priation made in 1892 for beginning work, and it consisted in making a channel 4 feet deep at mean low water and 60 feet wide up to the village of Westport, at an estimated cost of $10,000. This work was completed in 1896.

The river and harbor act of 1894 ordered a survey of Westport Harbor, which was made. The report of this survey is printed in Annual Report of Chief of Engineers for 1896, Part II, page 806. It is also printed with map as House Doc. No. 67, Fifty-fourth Congress, first session. It proposed a further improvement to provide for repairing the Cedar Point breakwater, removing a ledge opposite Stony Point, or dredging around it, and removing bowlders from the channel, at a total estimated cost of $8,000. Under the terms of the river and harbor act of 1896, appropriating $3,000 for improving Westport Harbor, Connecticut, the project of 1892 was extended to include this work, and the estimated cost was in consequence increased to $18,000.

A sketch of this river and harbor was printed in the Annual Report of the Chief of Engineers for 1894, page 670.

The total amount expended on this improvement up to the close of the fiscal year ending June 30, 1897, is $31,114.70, and on the same date the 4-foot channel was completed to Westport, the head of navigation, with width generally of 60 feet; but navigation was rendered difficult by several large bowlders lying near the margin of the dredged channel. The Cedar Point breakwater, repaired and extended in 1897, was in good condition. The canal through Great Marsh now has practically no water at low tide, and has not been used for general navigation since 1850.

At the beginning of the past fiscal year work upon removal of bowlders was in progress. This work was completed early in the month of July, and resulted in the removal of all the bowlders that could be found in the natural channel above the railroad bridge, and the present available depth is as stated above.

The commerce consists of coal, manufactured goods, farm produce, and miscellaneous articles. The improvements made have rendered navigation of the river practicable at less than full high water.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1893	222	6 to 11	100 to 300	44,400	.....	.....
1894	320	6 to 8	100 to 250	59,700	15,300	.....
1895	.....	6 to 10½	100 to 300	28,940	.....	30,760
1896	345	4 to 10½	50 to 300	33,507	4,567	.....

The reported value of this commerce for 1896 was $764,600.
No new lines of transportation have been established during the year.
Statistics for 1897 have not been received.

July 1, 1897, balance unexpended	$1,329.30
June 30, 1898, amount expended during fiscal year	780.20
July 1, 1898, balance unexpended	549.10
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix D 11.)

12. Norwalk Harbor, Connecticut.—Norwalk Harbor or River is a tidal estuary, with a narrow channel extending about 3 miles north from Long Island Sound to the town of Norwalk. Above Norwalk the river is a small fresh-water stream. South Norwalk is on the west bank of the river, 1½ miles below Norwalk. At this point the river is crossed by two drawbridges, the lower one a highway bridge and the other (450 feet above) the bridge of the New York, New Haven and Hartford Railroad. The mean tidal range is 7.12 feet.

In 1867 a company was incorporated under the laws of the State of Connecticut for the improvement of the river. Little work was done, and when the improvement was begun by the United States the low-water depth to South Norwalk was 5 feet and to Norwalk but 1 foot.

By act of March 2, 1829, Congress appropriated $80 "for making a survey of the harbor of Norwalk, Conn., with a view to its improvement." The survey was made and estimates were submitted for making a channel either 10 or 12 feet deep at ordinary high tide, but no money was appropriated for the improvement.

The river and harbor act of 1871 ordered another survey, which was made in that year. The report, printed in Senate Ex. Doc. No. 23, Forty-second Congress, second session, and also in the Annual Report of the Chief of Engineers for 1872, page 900, proposed dredging a channel 6 feet deep and 100 feet wide from Long Island Sound to Norwalk, at an estimated cost of $34,000. This project was adopted under the river and harbor act of 1872. In 1880 the project was modified so as to increase the depth below South Norwalk to 8 feet at mean low water, and the estimate of cost was increased to $84,000, to include this modification and the dredging which had already been done for maintenance of channels. This project was considered completed in 1892.

Under the terms of the river and harbor act of 1894, appropriating $15,000 for continuing this improvement, a project was adopted for dredging and removing the shoal called Ferrys Point, on the west side of the channel, between the railroad docks and Jenning's wharf, making 6 feet depth at mean low water, and, if funds should permit, for widening the bend at Keysers Island, near the harbor entrance, making a depth of 9 feet at mean low water, at a total estimated cost of $15,000.

A survey of Norwalk Harbor, ordered by the river and harbor act of 1894, was made, and the report, printed as House Doc. No. 50, Fifty-fourth Congress, first session, also in Annual Report of the Chief of Engineers for 1896, Part II, page 813, contained estimates for an extension of the improvement to provide for a channel 10 feet deep and 150 feet wide to South Norwalk, and for widening two bends at the harbor entrance, at a cost of $62,000. This project was adopted by the river and harbor act of 1896, which appropriated money for beginning work under it, and the project of 1894, thus modified, consists in removing the shoal at Ferrys Point to a depth of 6 feet at mean low water, in making a channel to South Norwalk 150 feet wide and 10 feet deep at mean low water, and in widening the two bends at the harbor entrance, at an estimated cost from the beginning, in 1894, of $77,000.

The maintenance of this channel and of the existing channel above South Norwalk is estimated to cost about $2,000 per year.

A sketch of Norwalk Harbor, Connecticut, was printed in the Annual Report of the Chief of Engineers for 1885, page 656, and a complete map of the harbor was published as House Doc. No. 50, Fifty-fourth Congress, first session.

The amount expended on this improvement to the close of the fiscal year ending June 30, 1897, was $107,444.02, and on that date a practicable channel 8 feet deep at mean low water extended from Long

Island Sound to the railroad bridge at South Norwalk, and a channel 6 feet deep at mean low water from the railroad bridge to the docks at Norwalk. The present project depth of 10 feet at mean low water is not available, because work under this project has covered a part of the channel only.

No work upon the improvement was done during the past fiscal year. Under date of November 30, 1897, a report upon the survey of the harbor of South Norwalk authorized in the river and harbor act of June 3, 1896, was made, and estimates for extending the project were submitted.

No examination has been made since the close of work in May, 1897, and, no reports to the contrary having been received, it is believed that the depths of 8 feet below and 6 feet above the railroad bridge at South Norwalk are still unimpaired.

The commerce of this harbor consists mainly of coal, lumber, oysters, and miscellaneous freights. The increased depth resulting from the improvements has been of benefit to all classes of vessels, and to much of the present commerce is absolutely indispensable.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1888	2,370	9 to 10	.....	438,600	.....	.....
1890	1,520	7 to 12	100 to 500	312,500	.....	126,100
1891	2,126	7 to 12	100 to 500	368,500	56,000	.....
1894	.....	.....	.....	136,800	.....	231,700
1895	861	4 to 18	50 to 600	201,095	64,295	.....
1896 *a*	993	4 to 14	50 to 600	146,045	.....	55,050

a Does not include trips made by 43 oyster steamers, with total tonnage of 2,505 gross tons.

The reported value of this commerce for 1896 was $5,184,349.
No new lines of transportation have been established during the year.
No statistics for 1897 have been received.

July 1, 1897, balance unexpended	$555.98
June 30, 1898, amount expended during fiscal year	107.15
July 1, 1898, balance unexpended	448.83

Amount (estimated) required for completion of existing project	52,000.00
Amount (estimated) required for maintenance annually	2,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, including maintenance	15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix D 12.)

13. Five-mile River Harbor, Connecticut.—This harbor is an inlet on the north shore of Long Island Sound, about 2 miles west of the mouth of Norwalk Harbor, Connecticut. It is about 1 mile long and from 300 to 800 feet wide. About three-fourths of a mile above its mouth it runs bare at low tide. At the mouth the natural low-water depth was 3 feet, increasing to 9 feet at a point 750 feet out into the sound. The mean rise of the tide is about 7 feet.

Since 1848 Five-mile River has been largely engaged in oyster growing, and in this business now employs about 140 vessels, which, without the improvement, could only enter or leave the harbor at high tide.

Consequently during their busy season they would be obliged to lie up for the night at other and less convenient harbors.

By act of Congress approved August 5, 1886, a survey or examination of this harbor was ordered, which was reported on under date of December 7, 1886 (printed in Annual Report of the Chief of Engineers for 1887, Part I, p. 639).

In this report a project for improvement was proposed, which consisted in dredging a channel 8 feet deep at mean low water and 100 feet wide, to extend up the harbor and to be about 6,000 feet long. The project was adopted in 1888, when work under it was ordered by appropriation of $5,000, made by act of Congress of August 11, 1888.

Harbor lines were established for this harbor by the Secretary of War January 26, 1892.

A sketch of Five-mile River Harbor was printed in the Annual Report of the Chief of Engineers for 1894, page 676.

Up to July 1, 1897, 97,952 cubic yards had been dredged under this project, making the channel about 4,180 feet long, 60 feet wide, and 8 feet deep at mean low water. The total amount expended on this improvement to June 30, 1897, is $17,307.84.

During the past fiscal year the dredged channel was widened 40 feet, making it 100 feet wide from the entrance to the lower docks, a distance of 2,250 feet.

At the close of dredging in December, 1897, the maximum depth was 8 feet at mean low water throughout the dredged channel; and that is believed to be the present depth, as nothing to the contrary has been reported.

The commerce of this harbor consists mainly of coal and shellfish. The increased depth has rendered possible the general use of the harbor by boats engaged in this business.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1889		2 to 7½	5 to 156			
1891		1½ to 8	2 to 175	10,000		
1892		1½ to 8	2 to 100			
1894	739			11,298	1,298	
1895	739			11,298		
1897 *a*	8,506	3 to 8	40 to 104	17,160	5,862	

a Includes trips made by 40 small oyster boats.

The reported value of this commerce for 1897 was $152,247.

No new lines of transportation have been established during the year.

The business of this harbor depends upon amount and value of oysters raised, rather than upon tonnage of freights.

July 1, 1897, balance unexpended	$2,692.16
June 30, 1898, amount expended during fiscal year	2,416.56
July 1, 1898, balance unexpended	275.60

Amount (estimated) required for completion of existing project	25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix D 13.)

14. Stamford Harbor, Connecticut.—This harbor is on the north shore of Long Island Sound, about 6 miles east of the New York State line. It consists of a bay about a mile long and a mile broad, at the head of which two channels extend up nearly a mile toward the middle of the city. The West Branch is the mouth of Mill River, a small stream dammed at Oliver Street Bridge, the head of the harbor. The original low-water depth for a mile below the bridge was from 1 to 3 feet in a crooked channel, and the 7-foot curve in the bay was about 7,500 feet below the bridge. All the wharves are in the upper half of this distance. The East Branch was originally a crooked stream running through salt marshes; it was straightened and deepened by private enterprise and was known as the "canal." Though nominally under control of the corporation which deepened it, the East Branch has been for a long time practically, and recently has been formally, opened to public use. In 1892 it had an available depth of 6½ feet at mean low water, with width of about 60 feet nearly to its head, which is about 1½ miles above its junction with the West Branch.

The mean rise of tide is 7.4 feet.

A survey of Stamford Harbor, ordered by act of Congress of March 2, 1829, was made, and with the report estimates were submitted for dredging channels either 10 or 12 feet deep at mean high water. No work was done under this plan.

The river and harbor act of 1882 authorized a survey of the harbor, which was made the following year. The report proposed improvement by dredging a channel through the West Branch 80 feet wide and 5 feet deep at mean low water, at an estimated cost of $20,000. The project was adopted under the river and harbor act of 1886, which made appropriation for beginning the work, and in December, 1891, after $20,000 had been appropriated and expended, the project was reported completed. The channel of the West Branch had been made 5 feet deep to the head of the harbor, with 80 feet width, except in the upper 1,000 feet, where the width was from 50 to 70 feet.

The river and harbor act of 1890 ordered a survey of Stamford Harbor. The report upon the survey presented a plan for further improving the West Branch, at an estimated cost of $95,000. Under the terms of the river and harbor act of 1892 this project was modified to include an improvement of the East Branch and was adopted as modified. The present approved project therefore consists in dredging in the West Branch to make a channel 150 feet wide and 7 feet deep at mean low water, with a basin between the harbor lines at the head of the harbor, and in the East Branch to make a channel 9 feet deep at mean low water, to be 100 feet wide for 8,535 feet, and thence to the head of the harbor, about 1,200 feet, to be 50 feet wide. The estimated cost from the beginning in 1892 is $123,500.

Harbor lines were established in the West Branch by the Secretary of War February 28, 1890.

A sketch of the harbor was printed in the Annual Report of the Chief of Engineers for 1893, page 956.

The amount expended to the end of the fiscal year ending June 30, 1897, was $45,723.05; and upon the same date the West Branch had a channel depth of 5 feet at mean low water, with width from 50 to 80 feet throughout its length, about 7,000 feet, and a channel 7 feet deep and 115 feet wide for 1,750 feet length at its lower end. The East Branch had a channel 9 feet at mean low water, from 60 to 80 feet wide up to the steamboat dock, about 8,000 feet, and thence for 1,200 feet from 40 to 60 feet wide.

During the past fiscal year, under a contract just commenced at the close of the year 1897, the channel of the West Branch was extended with full width for half a mile, and widened 40 feet to its full width of 150 feet over a distance of about half a mile, which completed the improvement of the West Branch up to the proposed basin opposite the docks. No examination has been made since this year's dredging closed; at that time the West Branch had a low-water depth of 7 feet for a mile up, and 5 feet above, and the East Branch had a depth of 9 feet in a narrow channel. It is thought that these depths still exist.

The commerce of this harbor consists mainly of coal, building materials, and unclassified freights. The improvements made have rendered access to the wharves much easier for the class of vessels used in this traffic.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1890	700	5 to 12	10 to 375	50,000	*a* 3,890	.....
1892	2,188	5 to 12½	.....	154,607	104,607	.....
1893	2,364	5 to 13	40 to 613	233,339	78,732	.....
1894	2,075	5 to 15	40 to 542	199,964	.....	33,375
1895	2,019	5 to 15	40 to 550	220,506	20,542	.....
1896	2,210	5 to 15	20 to 550	373,758	153,252	.....

a Over 1889.

The reported value of this commerce for 1896 was $11,316,647.

One new line of transportation was established during 1896, viz, the Stamford and Northport Ferry Line.

No statistics for 1897 have been received.

July 1, 1897, balance unexpended	$9,276.95
June 30, 1898, amount expended during fiscal year	8,570.48
July 1, 1898, balance unexpended	706.47
Amount (estimated) required for completion of existing project	88,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	12,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix D 14.)

15. Harbor at Coscob and Mianus River, Connecticut.—This harbor is a tidal inlet extending about 2 miles northwardly from Long Island Sound to the village of Mianus, at a point 4 miles east of the New York State line. It has a high-water width of from 800 to 2,000 feet, but the low-water channel is narrow and bounded by mud flats. At low tide there was in 1892, before the improvement of the harbor was begun, a natural depth of 7 feet or more, with width of about 200 feet for the first half mile, the depth above gradually decreasing to almost zero at the head of the harbor. About three-quarters of a mile below Mianus the stream is crossed by a drawbridge of the New York, New Haven and Hartford Railroad. The commerce of the harbor is practically confined to the supplies of the communities living along its shores. At Coscob, above the railroad bridge, is a shipyard, where a considerable number of small boats are repaired and some built. At Riverside, below the bridge, are the houses and docks of the Riverside Yacht Club.

The mean rise of tide is about 7½ feet.

Under authority of the river and harbor act of 1890 a survey of the harbor was made. The report on the survey, printed in the Annual Report of the Chief of Engineers for 1891, page 855, contains a plan and estimate for improvement by dredging to make a channel 6 feet deep at mean low water, with 150 feet width below the railroad bridge and 100 feet width above the bridge to Mianus, at an estimated cost of $36,000. This project was adopted under the river and harbor act of 1892, which made an appropriation for beginning work.

By act of August 18, 1894, Congress made appropriation for continuing the improvement, "including a survey of the lower part of the harbor with a view of making a turning basin therein." The report upon this survey, printed in the Annual Report of the Chief of Engineers for 1895, page 881, presented plans for a turning basin just inside the harbor entrance, to be 7 feet deep at mean low water and 300 feet wide, to be made by widening the channel on the west side for a length of 2,000 feet, measured along the channel, and 1,500 feet at the west side of the basin. The estimated cost was $18,000.

This modification of the project was adopted under the terms of the river and harbor act of 1896, and the present project for this improvement consists in dredging to make a channel 6 feet deep at mean low water, to be 150 feet wide up to the railroad bridge, and thence to Mianus to be 100 feet wide, with a turning basin on the west side of the channel near the harbor entrance 7 feet deep at mean low water, 300 feet wide, and extending 2,000 feet along the channel, at a total estimated cost of $54,000.

A sketch of Coscob Harbor and Mianus River was printed in the Annual Report of the Chief of Engineers for 1893, page 958, and one of the lower part of this harbor in the report for 1895, page 882.

The amount expended on this improvement to June 30, 1897, is $11,442.41; and to the same date the channel had been dredged 150 feet wide and 6 feet deep up to the railroad bridge, and of the same depth 100 feet wide for 1,300 feet above the bridge.

During the past fiscal year, under a contract commenced on the last day of the fiscal year 1897, one-half of the turning basin was dredged to project depth of 7 feet at mean low water. At the close of work in August the depth in dredged turning basin was 7 feet and in dredged channel 6 feet, and no impairment of same has been reported since that time.

The commerce of this harbor is mainly coal, lumber, and miscellaneous products. The benefit to commerce consists only in a broader and deeper channel in the lower part of the harbor, the increased depth being not yet extended to the upper landings.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1890	3,732	2 to 9	3 to 80	46,900	.....	.....
1894 *a*	342	4 to 8	25 to 100	51,600	4,700	.....
1897 *a*	424	4 to 8	25 to 100	61,500	9,900	.....

a The trips of 83 yachts which belong to the Riverside Yacht Club and anchor in this harbor are not included in the number of vessels given.

The reported value of this commerce for 1897 was $342,500.
No new lines of transportation have been established during the year.
Statistics between 1890 and 1894 and between 1894 and 1897 were not received.

July 1, 1897, balance unexpended	$7,557.59
June 30, 1898, amount expended during fiscal year	6,007.43
July 1, 1898, balance unexpended	1,550.16
Amount (estimated) required for completion of existing project	35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix D 15.)

16. Greenwich Harbor, Connecticut.—Greenwich Harbor is a shallow bay about 2 miles east from the New York State line and extending nearly a mile northward from Long Island Sound. Before improvement the upper part of the harbor ran bare at ordinary low water, and vessels landing at any of the docks, except those in the outer harbor, could enter only at full tide and with draft of not over 6 feet.

The mean rise of tide is about 7½ feet.

The preliminary examination of this harbor was made in compliance with the river and harbor act of 1894, and the report submitted in House Ex. Doc. No. 25, Fifty-third Congress, third session. It is also printed in the Report of Chief of Engineers for 1895, page 860. The improvement recommended was adopted under the river and harbor act of 1896, which appropriated money to begin the work.

Under date of September 26, 1896, a report upon the survey authorized by the river and harbor act of June 3, 1896, was made, and a project and estimate submitted. A channel 90 feet wide is to be made from the mouth of the harbor to a causeway at its head, a distance of about a mile, to be 9 feet deep at mean low water to the lower docks and 6 feet deep above. The upper end is slightly enlarged to form a turning basin. The estimated cost was $20,000. Harbor lines were established in 1895.

Up to June 30, 1897, no work had been done; a contract for dredging had been entered into.

During the fiscal year a channel 6 feet deep at mean low water and 45 feet wide was dredged from the 6-foot curve opposite the lower dock to the upper dock, near the upper end of the proposed channel, a distance of half a mile.

At the close of work on January 15, 1898, the low-water depth over the improvement was 6 feet, and it is believed that that depth still exists.

The commerce of Greenwich Harbor consists of coal, building materials, stone, and general merchandise. The improvement is designed to facilitate the transportation of this freight, which previous to the commencement of work could only be done at high water.

Table of comparative statistics.

Date.	Vessels of all kinds, each arrival and departure together being counted as one.			Freight tonnage.		
				Received and shipped.	Compared with preceding report.	
	No.	Draft.	Tonnage.		Increase.	Decrease.
		Feet.		*Tons.*	*Tons.*	*Tons.*
1894	.....	3 to 7	40 to 300	110,000	.....	.....
1897	.....	3 to 14	40 to 750	198,500	88,500	.....

The reported value of this commerce for 1897 was $5,432,500. One new line of transportation is contemplated.

July 1, 1897, balance unexpended	$5,389.09
June 30, 1898, amount expended during fiscal year	4,449.35
July 1, 1898, balance unexpended	939.74
July 1, 1898, outstanding liabilities	125.00
July 1, 1898, balance available	814.74

Amount (estimated) required for completion of existing project	14,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	14,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix D 16.)

SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The surveys of the following localities, required by the river and harbor act of June 3, 1896, were made by the local engineer, Maj. Smith S. Leach, Corps of Engineers, and reports thereon submitted:

1. Survey of Connecticut River between Hartford, Conn., and Holyoke, Mass.—Major Leach submitted report of survey November 13, 1897. The plan of improvement presented provides for securing between Holyoke and Hartford a channel 9 feet deep at extreme low water and 150 feet wide at the same stage, by the construction of three locks and movable dams and by dredging where required. The cost of the work, including that for flowage, is estimated at $1,825,000, but this total would be increased to $2,075,000 should the Chanoine type of dams be used, while the cost of maintenance, together with operation of the locks and dams, the necessary repairs to the same, and the small amount of dredging possibly required to keep open the artificial cuts, is estimated approximately at $8,000 per annum. The execution of the plans submitted would result in no injury to the canal on the west bank or to water power.

Reference is made to the fact that there are eleven bridges spanning the river between Hartford and Chicopee which would not permit traffic under the proposed project. One of these structures, a temporary highway bridge, at Hartford, will be replaced by a permanent one, the approved plan for which provides ample draw opening.

Major Leach states that a military reason of some weight for making the proposed improvement is the provision of water carriage to the United States arsenal at Springfield, and it is his opinion, concurred in by the division engineer, Col. G. L. Gillespie, Corps of Engineers, that the river is worthy of improvement by the General Government between Hartford and Holyoke in the manner and to the extent set forth.

The report was transmitted to Congress and printed in House Doc. No. 136, Fifty-fifth Congress, second session. (See also Appendix D 17.)

2. Survey of South Norwalk Harbor, Connecticut.—Major Leach submitted report of survey November 30, 1897. The approved project for improving Norwalk Harbor, of which the harbor at South Norwalk is a part, consists in removing the shoal at Ferrys Point to a depth of 6 feet at mean low water, in making a channel to South Norwalk 150 feet wide and 10 feet deep at mean low water, and in widening the two bends at the harbor entrance. Major Leach recommends amendment of the present project by including therein a branch channel to East

Norwalk 60 feet wide and 6 feet deep at mean low water, estimated to cost $5,760, by deepening the present channel above the railroad bridge to 8 feet at mean low water, at an estimated cost of $13,200, and by maintaining the project dimensions of channel over the entire harbor, at an estimated cost of $2,500 per annum.

In the opinion of the local officer the harbor of Norwalk is worthy of improvement by the General Government in the manner and to the extent set forth, and his views and recommendations are concurred in by the division engineer, Col. G. L. Gillespie, Corps of Engineers.

The report was transmitted to Congress and printed in House Doc. No. 129, Fifty-fifth Congress, second session. (See also Appendix D 18.)

IMPROVEMENT OF BAY RIDGE, RED HOOK, AND BUTTERMILK CHANNELS, NEW YORK HARBOR, OF RIVERS AND HARBORS IN NEW YORK ON LONG ISLAND SOUND, AND ON THE SOUTHERN SHORE OF LONG ISLAND.

This district was in the charge of Maj. H. M. Adams, Corps of Engineers, having under his immediate orders Lieut. Robert R. Raymond, Corps of Engineers, the entire year, and Lieut. James F. McIndoe, Corps of Engineers, since April 11, 1898. Division Engineer, Brig. Gen. G. L. Gillespie, U. S. Volunteers, colonel, Corps of Engineers.

1. Port Chester Harbor, New York.—This harbor, at the boundary between the States of New York and Connecticut, consists of a bay opening into Long Island Sound at the mouth of Byram River and of the lower part of the river itself, which is navigable for about a mile above its mouth.

The original available depth in the river was not more than a foot at low water, and Salt Rock in the river and Sunken Rock in the bay were considered dangerous obstructions.

The project for improvement, adopted in 1871, provided for the removal of these rocks to 9 and 11 feet depth, respectively, and for the construction of a breakwater at Byram Point, at the mouth of the harbor, the estimated cost being $96,632.

In 1884 the project was extended to provide for dredging a channel 2½ feet deep, and from 60 to 100 feet wide, from the bay to the vicinity of the village wharves. In 1888 the project was further modified to omit the removal of Sunken Rock and to build a breakwater from that rock to Byram Point, which should also serve as a beacon on the rock. A revised estimate of cost, made in 1890 in accordance with these modifications, reduced the cost of completion by about $40,000, making the total estimated cost $57,000.

Up to June 30, 1897, $51,813.45 had been expended. Salt Rock had been removed to 9 feet depth; the breakwater from Sunken Rock to Byram Point had been completed; a channel had been dredged up to Town Dock 8 feet deep at mean low water and 75 feet wide, thence to the steamboat landing 6 feet deep and 60 feet wide, and thence to the head of navigation 2½ feet deep.

No work was done during the past fiscal year.

The results of the work have been to admit vessels of greater draft than formerly, and to provide them with shelter while waiting for high tide to go to the landings.

The commerce of this harbor consists of coal, iron, building materials, farm produce, and miscellaneous freights, amounting to about 118,950 tons in 1897. The annual value of this commerce is estimated at about forty times the entire cost of the project when completed.

The following table shows the tonnage of commerce reported for this harbor for several years since 1885:

	Tons.
1885	81,000
1890	160,000
1893	163,000
1895	73,257
1896	114,749

No new lines of transportation have been reported as established since July 1, 1897.

July 1, 1897, balance unexpended	$186.55
June 30, 1898, amount expended during fiscal year	186.55
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix E 1.)

2. *Mamaroneck Harbor, New York.*—This harbor consists of a narrow inlet opening into a broad bay, with several dangerous rocks in or near the channel at head of the bay. The low-water depth to the old steamboat wharf halfway up the inlet was 5 feet; thence to the upper wharves it was about 1 foot.

A project for improvement, adopted in 1882, provided for removing one rock to 4 feet depth, five rocks to 7 feet depth, and for making a channel 100 feet wide and 7 feet deep at mean low water up to the old steamboat wharf, and thence to the upper wharves 80 feet wide and 4 feet deep, at an estimated cost of $43,000.

Up to June 30, 1897, $24,939.46 had been expended. One rock had been removed to 4 feet depth and two to 7 feet depth at mean low water, and a channel 60 feet wide and 6 feet deep at mean low water had been dredged from deep water in the bay to the upper wharves, a length of 3,550 feet.

During the past fiscal year no work was done.

The commerce of Mamaroneck Harbor is principally coal, building materials, farm produce, and general merchandise, amounting in 18 7 to 51,673 tons. The improvement has made the upper wharves accessible to vessels of 4 feet greater draft, and has made the entrance to the harbor safer and easier.

The annual value of the commerce is estimated at about twenty times the entire cost of the improvement, when completed.

No new lines of transportation have been established during the past fiscal year.

July 1, 1897, balance unexpended	$60.54
June 30, 1898, amount expended during fiscal year	60.54
Amount (estimated) required for completion of existing project	18,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix E 2.)

3. *East Chester Creek, New York.*—This is a small tidal stream emptying into Pelham Bay, at the west end of the north shore of Long Island Sound. Before improvement it was navigable at high tide for vessels drawing 7 feet only up to Lockwoods, a distance of 2¼ miles. The rise of tide is 7.1 feet.

The original project for improvement, adopted in 1873, provided for making a channel 100 feet wide and 9 feet deep at mean high water (about 2 feet at low water) from deep water in Pelham Bay to a point 3,000 feet above Lockwoods, at an estimated cost of $136,500, subsequently reduced to $124,000.

Up to June 30, 1897, $80,615.26 had been expended upon this improvement. The channel had been made the full depth and width up to a point 3,000 feet above Lockwoods; below Lockwoods, for a distance of half a mile, the depth had shoaled and the channel narrowed.

During the past fiscal year 14,869 cubic yards of sand, mud, loose and solid rock was removed from the channel between Town Dock and Lockwoods, making the channel from 90 to 100 feet wide.

The balance of funds remaining was not sufficient to effect any useful extension of channel.

The project of 1873 is considered completed; the channel is in good navigable condition to the point 3,000 feet above Lockwoods; no appropriation is required.

The commerce of East Chester Creek consists of coal, building materials, stone, and miscellaneous freights, amounting in 1896 to 94,928 tons.

The following table shows the variations in amount of commerce reported for several years since the first report in 1887:

	Tons.		Tons.
1887	16,110	1893	55,990
1890	19,505	1894	137,268
1892	47,115	1895	94,928

The value of this commerce in 1896 is estimated at about 18 times the entire cost of the completed improvement.

No new lines of transportation have been established during the past fiscal year.

July 1, 1897, balance unexpended	$10,384.74
June 30, 1898, amount expended during fiscal year	9,373.84
July 1, 1898, balance unexpended	1,010.90

(See Appendix E 3.)

4. Bronx River, New York.—The navigable part of this stream is the tidal part, extending about 3 miles from its mouth, and lying wholly within the limits of the city of New York. It has naturally a depth of 4 feet at the entrance, decreasing to less than 1 foot at the head of navigation, where the rise of tide is about 6 feet.

The project for improvement was adopted in compliance with the river and harbor act of 1896, and contemplates dredging and rock removal to make a channel 4 feet deep at mean low water, to be 100 feet wide at and near the mouth, decreasing to 50 feet at the head of navigation. The estimated cost is $85,985.

Up to June 30, 1897, $2,498.91 had been expended upon rock removal under a contract then in progress.

During the past fiscal year 123.63 cubic yards of rock was removed from three ledges in the lower part of the stream, deepening shoal places left under the contract; the total amount removed under the contract was 1,250 cubic yards, making a depth of 6 feet at mean low water where the previous available depth was about 1 foot, over about a half mile length of the river at a point 1½ miles above its mouth.

Future appropriations should be applied to the rock removal and dredging proposed under the adopted project.

The commerce of Bronx River consists principally of coal, lumber, *building materials, etc.*, amounting in 1897 to 139,310 tons, valued at

$526,025. This valuation is about six times the estimated cost of the projected improvement.

The following table shows previous freights, so far as reported:

	Tons.
1890, about	220,000
1896	94,244

July 1, 1897, balance unexpended	$7,501.09
June 30, 1898, amount expended during fiscal year	7,501.09
Amount (estimated) required for completion of existing project	75,985.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix E 4.)

5. *Mattituck Harbor, New York.*—This harbor is a tidal inlet extending about 2 miles south from Long Island Sound to the village of Mattituck, on Long Island, about 70 miles east from New York City. The natural depth at the entrance is from 1 to 2 feet at low tide; inside the entrance the depth is rather greater to the tide mill, about a mile from its mouth; above the tide mill slack high water is maintained, with depth of about 6 feet to Mattituck. The rise of tide outside the harbor's mouth is 4.8 feet and below the tide mill but 2.2 feet.

The project for improvement, adopted under the terms of the river and harbor act of June 3, 1896, contemplates making a channel of 7 feet depth at mean low water, to be 100 feet wide at the entrance, and thence to the tide mill to be 80 feet wide, and extending the same to the village of Mattituck with depth of 7 feet at high water and 80 feet width, the entrance channel to be protected by parallel jetties. The estimated cost of this work is $83,000.

No work has been done under this project and no money expended.

In carrying out the project for improvement the first work done should be the construction of the jetties at the entrance, estimated to cost about $40,000. The available funds are sufficient to build only one-half of one of the jetties, which would be of no benefit to navigation. Therefore, it is proposed to defer the beginning of work until sufficient funds are provided to build one or both jetties, which could be done in one working season.

The commerce of Mattituck Harbor consists of farm produce and fertilizers, amounting in 1890 to about 3,000 tons, valued at $33,470. The greater part of the local freight was received and shipped by rail.

July 1, 1897, balance unexpended	$10,000.00
July 1, 1898, balance unexpended	10,000.00
Amount (estimated) required for completion of existing project	73,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix E 5.)

6. *Port Jefferson Harbor, New York.*—This harbor is a large and deep inland bay with a narrow entrance or inlet, outside of which was originally a shoal with 4 feet depth at low water. The location of the inlet is one of the most exposed on Long Island Sound.

The first project for improvement was adopted in 1871 and completed in 1883 at a total cost of $79,000. Two jetties were built to shelter the inlet channel, one east of the inlet, 1,390 feet long, and one west, 940 feet, both to scant cross section. A channel 8 feet deep at mean low water and 100 feet wide was dredged through the inlet and the shoal outside.

An examination of Port Jefferson Inlet was made under the river and harbor act of 1888, and under the act of 1890 a project for improvement was adopted providing for a depth of 10 feet at mean low water. This was modified in compliance with the terms of the river and harbor act of 1894, to make a depth of 12 feet, and the present project for improvement therefore provides for a channel through the harbor entrance 12 feet deep at mean low water and 200 feet wide, to be made by dredging and to be protected by extending and enlarging the previously built breakwaters, at an estimated cost of $145,000.

Up to June 30, 1897, $43,978.34 had been expended upon the present project, exclusive of $4,735.46 outstanding liabilities; both jetties had been partly enlarged, a channel 10 feet deep at mean low water and over 200 feet wide had been dredged through the entrance bar, and from 160 to 180 feet width of this channel had been further deepened to 12 feet.

During the past fiscal year 1,138 cubic yards was dredged, removing a shoal from the 12-foot channel.

Future appropriations will be applied to enlarging and extending the jetties and to maintaining the 12-foot channel.

The commerce of this harbor consists of coal, building materials, farm produce, shellfish, and general merchandise, amounting in 1897 to 25,497 tons. The harbor is also largely used as a winter anchorage for yachts. The result of the improvement has been to render access to the harbor comparatively easy and safe.

The annual value of the commerce of the harbor in 1897, exclusive of shipbuilding and repairing, is estimated at about twice the total cost of the present project.

The following table shows the recent variations in the commerce reported:

	Tons.		Tons.
1890	42,325	1894	42,000
1892	47,000	1895	36,000
1893	46,000	1896	31,700

No new lines of transportation are reported as established during the past fiscal year.

July 1, 1897, balance unexpended	$6,021.66
June 30, 1898, amount expended during fiscal year	5,242.45
July 1, 1898, balance unexpended	779.21
Amount (estimated) required for completion of existing project	95,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	12,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix E 6.)

7. *Huntington Harbor, New York.*—This is a tidal inlet extending southward from Huntington Bay to the village of Huntington. It is about 2 miles long, quite narrow, and landlocked, and has a natural available depth of nearly 8 feet at mean low water up to within three-fourths of a mile of the head of the harbor, where the low-water depth shoaled gradually to zero.

In 1872–73 a channel 8 feet deep and 150 feet wide was dredged in the upper part of the harbor by the United States at a cost of $22,500. Within ten years following this had nearly filled up.

In 1884 a survey was ordered by Congress, and under authority of the river and harbor act of 1890 a project for improvement was adopted, providing for redredging a channel 8 feet deep and 100 feet wide up to the upper wharves, at an estimated cost of $32,000. The

estimate also includes a pile protection for part of the channel, but it seems probable that equally good results can be obtained by applying the funds to dredging a greater width.

Up to June 30, 1897, $21,680.23 had been expended under the present project in dredging a channel 8 feet deep at mean low water, 175 feet wide up to the bend at the old town dock, 230 feet wide at the bend, and 100 feet wide for about 200 feet above the bend, a total length of about 3,500 feet.

No work has been done during the past fiscal year.

Future appropriations will be applied to such dredging as is necessary for completing and maintaining the channel.

The commerce consists mainly of coal, building materials, and miscellaneous freights, amounting to 23,584 tons in 1897.

Vessels which formerly waited for high tide to reach the landings now reach them at any ordinary stage of water.

The present annual value of this commerce is estimated at about fifteen times the entire cost of the present project when completed.

The following table shows the variations in reported tonnage of commerce for several years since 1890:

	Tons.		Tons.
1890	39,500	1894	58,000
1892	44,000	1895	70,000
1893	46,000	1896	73,350

No new lines of transportation are reported as established during the past fiscal year.

July 1, 1897, balance unexpended	$319.77
June 30, 1898, amount expended during fiscal year	319.77
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix E 7.)

8. *Glencove Harbor, New York.*—This harbor is an inlet on the east side of Hempstead Harbor, which is accessible only at high tide, and a breakwater was needed to shelter vessels while at anchor waiting for tides.

The project for improvement, adopted in 1888, provided for a riprap breakwater about 2,500 feet long, extending in a west-southwesterly direction from the northwest corner of the Glencove Dock, the top to be 5 feet wide and 3 feet above mean high water, and slopes to be 1 on 1. Its estimated cost was $201,960. In 1895 the project was modified to limit the length of the breakwater to about 2,000 feet, and revised estimates were made, based upon the cost of work already done, and reducing the estimate of cost, from the beginning of work in 1888, to $135,000.

Up to June 30, 1897, $62,429.74 had been expended in building 1,465 linear feet of breakwater.

The only work done during the past fiscal year has been maintaining a light upon the end of the unfinished breakwater.

The commerce of Glencove Harbor consists chiefly of coal, corn, starch, glucose, and miscellaneous freights, amounting in 1897 to 733,400 tons. The annual value of these freights is estimated at about thirty times the cost of the completed improvement.

The result of this improvement has been to afford a shelter which enables vessels to use the Glencove Dock in all weather or to lie

securely at anchor until the rise of tide makes the inner harbor of Glencove navigable.

Following is a statement of the amounts of commerce for the several years since 1889 as far as presented.

	Tons.
1889	301,429
1893	305,000
1896	106,435

July 1, 1897, balance unexpended	$570.26
June 30, 1898, amount expended during fiscal year	205.20
July 1, 1898, balance unexpended	365.06
July 1, 1898, outstanding liabilities	16.00
July 1, 1898, balance available	349.06

Amount (estimated) required for completion of existing project	72,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix E 8.)

9. *Flushing Bay, New York.*—Before improvement the available depth in this broad, shallow bay and in the channel leading up to Flushing was less than 4 feet at mean low water.

The project for improvement, adopted in 1879, contemplated building 16,700 feet of diking to form a tidal basin which, by filling and discharging through the main channel, would maintain a channel depth of 6 feet or more at mean low water, after once dredging. The bottom is soft mud. The estimated cost of this work was $173,500.

In 1888 the project was modified to omit part of the diking, which then appeared unnecessary, and in 1891, at the request of many citizens, the extension of dikes was wholly omitted from the project.

Up to July 1, 1897, $122,374.76 had been expended; 4,663 linear feet of diking had been built and a channel 100 feet wide and 6 feet deep at mean low water had been dredged, in places several times.

No work was done during the past year.

Future appropriations should be applied mainly to such dredging as may be needed to keep the channel free from shoals.

The improvement of Flushing Bay has resulted in making the water front accessible to many of the vessels even at low tide and in permitting the use of vessels of increased draft at high tide.

The commerce of Flushing Bay consists chiefly of coal, building materials, dyewoods, manufacturers' and miscellaneous freights, amounting in 1897 to 163,395 tons, valued at $1,449,438. This value is about eight times the cost of the improvement.

Following is a statement of the amounts of commerce reported for Flushing Bay during the several years since 1888:

	Tons.
1888	229,235
1894 (partial returns)	46,942
1895	150,376
1896	80,820

July 1, 1897, balance unexpended	$625.24
June 30, 1898, amount expended during fiscal year	119.37
July 1, 1898, balance unexpended	505.87

Amount (estimated) required for completion of existing project	50,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix E 9.)

10. Patchogue River, New York.—This is a shallow tidal inlet extending about a mile northward from the shore of Great South Bay, Long Island, to the village of Patchogue. The natural depth in the stream and over a bar at the mouth was from 2 to 3 feet at mean low water, and the rise of tide is about 1 foot.

In 1880 and in 1886 examinations were made by order of Congress, and in 1890 a project was adopted for making a channel 6 feet deep at mean low water and 60 feet wide from Great South Bay to the village wharves, about 5,000 feet, and for protecting the entrance channel by a jetty 1,700 feet long on the west side, at an estimated cost of $40,000.

Up to June 30, 1897, $34,041.53 had been expended. The jetty on the west side of the entrance had been completed to the proposed length of 1,700 feet, and a channel 6 feet deep at mean low water and 60 feet wide had been dredged from Great South Bay to 80 feet below the harbor lines at the head of the harbor, 300 feet at the upper end being further widened to 100 feet so that vessels could turn about.

During the past fiscal year the shoals in the previously dredged channel were removed to a depth of 6 feet.

The project for this improvement is completed.

The commerce of Patchogue River consists mainly of lumber, coal, fish, and shellfish, amounting in 1897 to 250,000 tons, valued at $3,605,000. This value is 90 times the entire cost of the improvement.

The improvement has enabled vessels of 6 feet draft to reach the channel opposite the docks at ordinary tides without lightering.

Following is a statement of the amounts of commerce of Patchogue River reported for several years since 1890:

	Tons.		Tons.
1890	56,000	1894	145,000
1892	120,000	1895	129,485
1893	125,000	1896	143,500

July 1, 1897, balance unexpended	$5,958.47
June 30, 1898, amount expended during fiscal year	5,247.87
July 1, 1898, balance unexpended	710.60

(See Appendix E 10.)

11. Browns Creek, Sayville, N. Y.—This is a narrow stream extending northward from Great South Bay to the Sayville Highway Bridge, above which it is wholly a fresh-water creek. The natural depth in the creek was 1 to 3 feet at low tide, and on a bar at the mouth it was less than 1 foot.

In 1890 a project was adopted for making a channel 100 feet wide and 4 feet deep at mean low water up to the highway bridge, the entrance channel to be 2 feet deeper and to be protected by riprap jetties on either side, at an estimated cost of $46,000.

Up to June 30, 1897, $21,053.78 had been expended; the west jetty had been made 492 feet long and the east jetty 438 feet long, and a channel had been dredged 100 feet wide, 4 feet deep at mean low water, and 1,893 feet long.

During the past fiscal year, the dredged channel was extended 1,100 feet, making it 2,993 feet long, and shoals in and near the entrance channel were deepened.

The object of the improvement is to provide a shelter for small oyster and fishing boats owned and operated in the vicinity. The channel already dredged is largely used by such boats for this purpose.

Future appropriations should be applied to maintaining and extending the channel and *to completing the jetties.*

The commerce of Browns Creek consists principally of shellfish, coal, lumber, etc., amounting in 1897 to 9,180 tons.

The annual value of the reported commerce is about four times the cost of the completed improvement.

The amounts of commerce reported heretofore are as follows:

	Tons.
1895	36,080
1896	86,871

July 1, 1897, balance unexpended	$3,946.22
June 30, 1898, amount expended during fiscal year	3,946.22
Amount (estimated) required for completion of existing project	21,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	6,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix E 11.)

12. Canarsie Bay, New York.—Canarsie Bay is the northwest part of Jamaica Bay, at Canarsie Landing. The original natural depth to the landing was 4½ feet at low tide, the rise of tide being 4.7 feet.

In 1880 a project for improvement by dikes solely, subsequently modified to diking and dredging, was adopted in order to secure a channel 100 to 150 feet wide and 6 feet deep at mean low water, connecting Canarsie Landing with Big Channel, in Jamaica Bay; it was afterwards extended to include a south channel from the landing to Island Channel, to be 4 feet deep. The estimated cost was $88,000.

Up to June 30, 1897, $64,470.59 had been expended. Two dikes had been built, one on the north side of the channel 1,058 feet long and one on the south side 820 feet long; the main channel had been dredged 6 feet deep at mean low water and 125 to 150 feet wide for its full length; a channel 5 feet deep and 50 feet wide had been dredged to connect with Gophel Channel on the northeast, and another 4 feet deep to connect with Island Channel on the southwest.

During the past fiscal year no work was done.

Future appropriations should be applied mainly to keeping the dikes in repair and to maintaining the dredged channels.

The commerce of Canarsie Bay consists mainly of building materials, fertilizers, fish, and coal, amounting in 1896 to 50,087 tons.

The annual value of this commerce is estimated at about five times the total cost of the improvement when completed.

This commerce is benefited by the increased depth to the landing, which obviates the delay awaiting the rising of the tide. The most important use of the channel is the transportation of passengers to summer resorts on Rockaway Beach.

The following is a statement of amounts of commerce reported for several years since 1890:

	Tons.		Tons.
1890	50,898	1894	133,425
1892	67,510	1895	148,564
1893	69,510	1896	50,087

July 1, 1897, balance unexpended	$529.41
July 1, 1898, balance unexpended	529.41
Amount (estimated) required for completion of existing project	23,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix E 12.)

13. Bay Ridge Channel, the triangular area between Bay Ridge and Red Hook channels, and Red Hook and Buttermilk channels, in the harbor of New York.—These channels lie along the east shore of the Upper Bay, New York Harbor, and, in the sequence named, form an eastern channel between the Narrows and the East River, separated from the main channel by a broad shoal off the mouth of Gowanus Bay and by Governors Island. The lower part of this waterway, consisting of Bay Ridge and Red Hook channels, had a natural low-water depth of 7 to 12 feet; Buttermilk Channel had a natural depth of 26 feet in a narrow, crooked channel, with Buttermilk and Red Hook shoals on either side.

Prior to 1896 this improvement was carried on under two separate projects, one for improving Buttermilk Channel, adopted in 1880 and modified subsequently so as to provide for the removal of Buttermilk and Red Hook shoals to 26 feet depth at mean low water, at an estimated cost of $529,000, and one for improving Gowanus Bay channels, adopted in 1881 and subsequently modified so as to provide for dredging Bay Ridge Channel 800 feet wide and 26 feet deep, Red Hook Channel 400 feet wide and 26 feet deep, dredging the triangular area between these channels to the same depth, and making Gowanus Creek Channel 250 feet wide and 21 feet deep, at a total estimated cost of $1,124,400.

Up to June 30, 1897, $493,962.68 had been expended upon Buttermilk Channel and $640,041 upon the Gowanus Bay channels. Buttermilk Shoal, at the upper end of Buttermilk Channel, had been completely removed to 26 feet depth at mean low water, and 600 feet had been removed from the northwest side of the Red Hook Shoal to the same depth; the Bay Ridge Channel had been made 375 feet wide and 21 feet deep, with a depth of 26 feet for 175 to 200 feet of this width, and the Red Hook Channel had been made 350 feet wide and 21 feet deep, with 26 feet depth for 200 feet of this width.

By the terms of the river and harbor act of 1896 these works were consolidated and a small improvement of Gowanus Canal was added, and the adopted project now consists in dredging channels of 26 feet depth at mean low water, with widths as follows: For Bay Ridge Channel, 800 feet; for the triangular area between Bay Ridge and Red Hook channels, maximum width, 900 feet; for the Red Hook Channel, 400 feet; for Buttermilk Channel at Red Hook Shoal, 1,000 feet, and for dredging Gowanus Canal from Percival street to Hamilton Avenue Bridge to the extent of $5,000; at a total estimated cost of $837,300. The item in the act is as follows:

Improving Bay Ridge Channel, the triangular area between Bay Ridge and Red Hook channels, and Red Hook and Buttermilk channels, in the harbor of New York, New York: Continuing improvement, two hundred thousand dollars: *Provided*, That the work shall be begun at the southerly end of Bay Ridge Channel and continue through it and the others in the order named, until each, as the work advances northerly, is completed in turn, so that each shall have a uniform mean low-water depth of twenty six feet and width as recommended for each: *And provided further*, That out of said sum five thousand dollars shall be expended in dredging Gowanus Canal from Percival street to Hamilton Avenue Bridge: *And provided further*, That contracts may be entered into by the Secretary of War for the completion of the whole of said work, to be paid for as appropriations may be made from time to time by law, not exceeding in the aggregate six hundred and thirty-seven thousand three hundred dollars, exclusive of the amount herein and heretofore appropriated.

Up to June 30, 1897, $94,439.69 had been expended under the project of 1896. Bay Ridge Channel, below Forty-third street, had been widened to its projected width of 800 feet, with 26 feet depth; above Forty third street it had been widened to 270 feet; the improvement of Gowanus Canal, as projected, had been completed.

During the past fiscal year Bay Ridge Channel has been widened to 800 feet for its entire length; the triangular area between Bay Ridge and Red Hook channels has been made full depth and width, and Red Hook Channel has been made full depth (26 feet) for about three-fourths its length, with width in different stages of progress.

Work on Red Hook Shoal, Buttermilk Channel, has not been begun.

The available funds and future appropriations will be applied to completing the work in the order prescribed by the act of Congress of June 3, 1896.

The commerce of this part of New York Harbor consists of coal, grain, lumber, iron, and other freights, amounting in 1897 to 12,353,171 tons, valued at $569,826,961. The amount of commerce in transit through these channels can not be estimated.

The improvement already made has resulted in making these channels available for vessels of much greater draft than formerly.

BAY RIDGE, RED HOOK, AND BUTTERMILK CHANNELS.

July 1, 1897, balance unexpended		$455,560.31
Amount appropriated by sundry civil act approved July 1, 1898		130,000.00
		585,560.31
June 30, 1898, amount expended during fiscal year		193,770.74
July 1, 1898, balance unexpended		391,789.57
July 1, 1898, outstanding liabilities	$59,847.39	
July 1, 1898, amount covered by uncompleted contracts	172,030.68	
		231,878.07
July 1, 1898, balance available		159,911.50

CHANNEL IN GOWANUS BAY, NEW YORK.

July 1, 1897, balance unexpended	$1,059.00
June 30, 1898, amount expended during fiscal year	1,059.00

BUTTERMILK CHANNEL, NEW YORK.

July 1, 1897, balance unexpended	$2,387.32
July 1, 1898, balance unexpended	2,387.32

(See Appendix E 13.)

14. Gowanus Creek Channel, New York Harbor.—That part of Gowanus Creek improved under the title of Gowanus Creek Channel is the part from the foot of Percival street on the east to the junction of Red Hook and Bay Ridge channels on the west.

Before improvement Gowanus Creek Channel had an available low-water depth of about 11 feet.

In 1881 a project for improvement of the several channels in Gowanus Bay was adopted which, as subsequently modified, provided for making a depth of 21 feet at mean low water in the Gowanus Creek Channel, with width extending to the harbor lines on either side. This was accomplished in 1893 under parts of appropriations made for the several channels, of which it is estimated that about $75,000 was applied to Gowanus Creek Channel.

Up to July 1, 1896, about $75,000 had been expended on this work. The channel had been made 21 feet deep at mean low water to the harbor lines on either side, and the project was completed.

Under the terms of the river and harbor act of 1896 a project was adopted for making the Gowanus Creek Channel 26 feet deep at mean low water between the foot of Percival street and Red Hook Channel, at a total estimated cost of $70,000.

Up to June 30, 1897, $11,129.50 had been expended under this project, and the channel throughout the creek from Red Hook Channel up to the foot of Percival street, a distance of 3,000 feet, had been made 26 feet deep at mean low water and about 100 feet wide, under a contract then nearly completed.

During the past fiscal year this contract was completed and the 26-foot channel was further widened 25 feet, making it 125 feet wide.

The commerce received and shipped in Gowanus Creek consists of coal, lumber, building materials, and miscellaneous goods, amounting in 1897 to 215,352 tons, valued at $2,631,752. In addition 2,083,680 tons passed through Gowanus Creek Channel to and from Gowanus Canal, valued at $20,000,000 or over, making a total of 2,299,032 tons. The annual value of this commerce is about three hundred times the total cost of the present project.

The improvement has resulted in admitting to this channel vessels of 15 feet greater draft than formerly.

Following is a statement of the tonnage of commerce reported at docks of Gowanus Creek, New York:

	Tons.
1895	366,299
1896	220,748
1897	215,352

July 1, 1897, balance unexpended	$13,870.50
June 30, 1898, amount expended during fiscal year	12,829.31
July 1, 1898, balance unexpended	1,041.19
Amount (estimated) required for completion of existing project	45,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix E 14.)

15. Newtown Creek, New York.—This is a tidal stream about 4 miles long, extending from the eastern part of the city of Brooklyn to the East River, opposite Thirty-fourth street, New York City. It had formerly a depth of 12½ feet at mean low water at the mouth, decreasing to 4 feet at the head.

In 1880 a project for improvement was adopted which provided for deepening the channel near the mouth of the creek at an estimated cost of $36,250, subsequently increased to $44,050. The river and harbor act of 1882 ordered a survey of the creek from its mouth to the Metropolitan Avenue Bridge, and under the appropriation of 1884 the project was extended to include this section of the creek and to make a channel throughout of 21 feet depth and 200 feet width at and near the mouth, decreasing to 10 feet depth and 100 feet width at the head, at a total estimated cost of $255,500.

July 1, 1896, the channel had been made 18 feet deep and from 150 to 175 feet wide up to Vernon Avenue Bridge, a distance of 2,300 feet, with a narrow channel 21 feet deep, and above this bridge it had been dredged to depths of 18 to 10 feet with widths of 100 to 40 feet up to the Metropolitan Avenue bridge, at a cost of $197,500.

Under the terms of the river and harbor act of 1896 the project was modified to provide for a channel up to the Metropolitan Avenue bridge, to be uniformly 125 feet wide and 18 feet deep at mean low water, at a cost not to exceed $450,000, and a contract for the completion of the project was entered into. The projected work can be completed at a cost of about $213,000.

Up to June 30, 1897, $20,953.67 had been expended under the modified project, and the channel, 125 feet wide and 18 feet deep, had been extended upward from Vernon avenue a distance of 7,500 feet.

Dredging has been continued during the past fiscal year, and the channel has been deepened as projected for about 7,000 feet farther. Work is still in progress.

The commerce of Newtown Creek consists principally of coal, building materials, petroleum and petroleum products, chemicals, etc., amounting in 1897 to 3,228,544 tons, valued at $54,446,931. The estimated annual value of this commerce is about one hundred times the aggregate of amounts appropriated for Newtown Creek.

Commercial statistics in tons for the years 1896 and 1897 are as follows:

	Tons.
1896	2,740,482
1897	3,228,544

The improvement of the channel has rendered much of this commerce possible, and has saved lighterage on much more.

July 1, 1897, balance unexpended		$192,046.33
June 30, 1898, amount expended during fiscal year		69,712.24
July 1, 1898, balance unexpended		122,334.09
July 1, 1898, outstanding liabilities	$18,079.94	
July 1, 1898, amount covered by uncompleted contracts	93,164.87	
		111,244.81
July 1, 1898, balance available		11,089.28

(See Appendix E 15.)

16. Removing sunken vessels or craft obstructing or endangering navigation.—A vessel, name unknown, sunk in Newtown Creek, New York, several years ago, became a source of danger to navigation when the channel was widened by dredging. In August, 1897, she was lifted bodily and towed away to wreckage yards in Weehawken, N. J. The amount expended on removal of wrecks is $200.

(See Appendix E 16.)

Major Adams was also charged with the duty of making a survey of Wallabout Channel, New York, and his report of the results will be submitted to Congress at its next session.

IMPROVEMENT OF HARLEM AND EAST RIVERS AND OF NEW YORK HARBOR, NEW YORK.

This district was in the charge of Brig. Gen. William Ludlow (now Maj. Gen.), U. S. Volunteers, lieutenant-colonel, Corps of Engineers, to April 21, 1898, and of Maj. H. M. Adams, Corps of Engineers, since that date, these officers having under their immediate orders Lieut. Robert McGregor, Corps of Engineers, the entire year, and Lieut. Edwin R. Stuart, Corps of Engineers, since April 16, 1898. Division Engineer, Brig. Gen. G. L. Gillespie, U. S. Volunteers, colonel, Corps of Engineers, since April 21, 1898.

1. Harlem River, New York.—The Harlem River and Spuyten Duyvil Creek are both included in this improvement.

Originally there was no navigable waterway between the two streams, as the bed of the connecting reach at Kingsbridge was a long reef of solid rock, bare at low water. The head of navigation at low tide in the Harlem River was practically at High Bridge, 5 miles from its junction with East River at Hell Gate, for vessels of 7 feet draft, and at high tide in Spuyten Duyvil Creek, near Kingsbridge, 1¾ miles from the Hudson, for vessels of 8 feet draft.

The object of the improvement is to form a navigable channel between the East and Hudson rivers.

The project for the improvement, as originally adopted in 1875, was for a channel 350 feet wide and 15 feet deep at mean low water. In 1879 the project was so far modified as to increase the width of the channel in the Harlem River and Spuyten Duyvil Creek to 400 feet, retaining the original width of 350 feet through Dyckman Meadow, but increasing the depth there to 18 feet, mean low water. This project was revised in 1886 by narrowing the channel immediately north of High Bridge, where it skirts the Ogden estate on the east bank, to a least width of 375 feet.

The estimated cost of the work was $2,700,000.

Up to June 30, 1897, $1,031,240.66 had been expended. The channel from the Hudson River to the Dyckman Cut had been made 12 feet deep and 200 feet wide or over; the rock cut through Dyckman Meadow had been completed to the depth and width projected, 350 feet wide and 18 feet deep, and from the rock cut to East River the channel had been made 12 feet deep, with widths from 150 to 180 feet or more.

During the past fiscal year the reach of channel between the Hudson River and the west end of the rock cut was widened 30 to 60 feet at the most contracted places, and from the rock cut eastward to McComb Dam Bridge the channel was widened from 30 to 100 feet; bowlders and projecting ledges have been removed opposite Mott Haven Canal, at the crossover near Morris Dock, and at and above McCombs Dam Bridge; retaining walls and revetments have been built to maintain the channel banks at the point of meadow south of Fordham Bridge and on the north side of Dyckman Meadow Cut, east of Broadway.

The channel is now 12 feet deep and over, and from 200 to 280 feet wide, from the Hudson River to the east end of Dyckman Meadow Cut, and thence 180 to 300 feet wide to McComb Dam Bridge. From this point south to Wards Island, East River, the available channel is 15 feet deep and over, and nowhere less than 150 feet wide.

To complete the project there remains the widening of the channel to 350 and 400 feet, and the deepening to 15 feet at mean low water where that depth has not already been obtained, by dredging and rock removal and revetting the edges of the cuts in places where the banks are steep and loose.

The commerce of the river for the year 1895 amounted to 7,533,594 tons, consisting of general merchandise, grain, flour, feed, lumber, building material, fuel, etc., having a total valuation of $203,707,376. The commerce in 1887, when work on the improvement was first begun, amounted to 2,524,155 tons, or less than one-half of the present tonnage. The estimated cost of the improvement is $2,700,000, being about 1 per cent of the value of the present annual commerce.

July 1, 1897, balance unexpended	$113,759.34
June 30, 1898, amount expended during fiscal year	103,768.28
July 1, 1898, balance unexpended	9,991.06
July 1, 1898, outstanding liabilities	595.93
July 1, 1898, balance available	9,395.13

Amount (estimated) required for completion of existing project	1,555,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	200,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix F 1.)

2. East River and Hell Gate, New York.—East River is the designation of the narrow tidal strait which connects New York Harbor with Long Island Sound. It forms a commercial entrance secondary in importance only to the main entrance via Sandy Hook and the Narrows, as the heavy coasting trade carried on by New York and the New England States and the British American Provinces uses it almost exclusively.

The East River is crooked and narrow, much obstructed by rocks and reefs, and traversed by powerful tidal currents. Especially was this the case at Hell Gate, where the channel turns at right angles around Hallets Point, Astoria, and the current runs with a velocity varying at different stages of the tide from 3 to 10 miles an hour over or around Way Reef, Pot Rock, Shell Drake, Frying Pan, Hallets Point, Negro Point, Holmes Rock, Hog Back, Heel Tap, Flood Rock, Hen and Chickens, Gridiron, Mill Rocks, The Negro Heads, Rhinelander Reef, and Bread and Cheese.

Hallets Point projected from the shore at Astoria under water 325 feet to the 26-foot contour, mean low water, and embraced an area of 3 acres.

The detached rocks in the waterway had varying depths over them. The Middle Reef, with an area of about 9 acres, lay in the middle of the channels at Hell Gate.

It had a backbone projecting above high water, called Flood Rock, upon which vessels were frequently stranded at ebb tide when the currents swept directly over the rock. To the northward, near the mouth of the Harlem River, lay the two Mill Rocks, both of which were usually visible at high water. To the eastward, Frying Pan had only 11 feet, mean low water; Heel Tap, 12 feet; Pot Rock, 20 feet, and North Brother Island Reef, 16 feet.

The project of improvement, adopted in 1867, provided for the removal to the depth of 26 feet, mean low water, of the rocks and reefs that lay directly in the channel at Hell Gate and for the construction of sea walls and dikes upon others that lay near the edge of the channel. The estimated cost of the project, revised in 1870, was $4,689,820.

Besides the obstructions before enumerated, submerged rocks were known to exist at other points in the channel, such as Diamond Reef, 15½ feet, mean low water, off the Battery; Coenties Reef, 14.3 feet, mean low water, off Coenties Slip; Shell Reef, 9 feet, mean low water, between Eighth and Tenth streets; Ferry Reef, 7 feet, mean low water, and Charlotte Rock, 14½ feet, mean low water, opposite Thirty-fourth street; the Middle Ground, 11½ feet, mean low water, off Sunken Meadow, at the entrance to Little Hell Gate, and Mid-Channel Reef, 16½ feet, mean low water, at Baretto Point, opposite Rikers Island.

The project was enlarged in 1874, and the total cost estimated at $5,139,120. (Annual Report, Chief of Engineers, 1874, Part II, p. 164.) Besides the improvements already projected at Hell Gate, the new project provided for the construction of a riprap dike to connect the Mill Rocks, sea walls upon Hog Back and Holmes Rock, and the removal to a depth of 26 feet of the small rocks known as Scaly Rock, Blackwells Rock, and the rock off Woolsey's bath house, and to 24 feet depth off Diamond Reef and Coenties Reef.

The project was again enlarged in 1884 to provide for the removal of Pilgrim Rock, opposite Nineteenth street, to 24 feet, mean low water; in 1889, for the removal of reef off Diamond Reef to 26 feet, mean low water; and of Ferry Reef and Charlotte Rock, opposite Thirty-fourth street, to 26 feet, mean low water; in 1890, for the removal of Shell Reef and reef off Sunken Meadow to 18 feet, mean low water; and in 1892 for the removal of Baretto Reef to 24 feet, mean low water.

Up to June 30, 1897, $4,371,323.19 had been expended. Hallets Point, covering 3 acres, Way Reef, Shell Drake, Diamond Reef, North Brother Island Reef, Coenties Reef, reef off Diamond Reef, Baretto Reef, Scaly Rock, Charlotte Rock, and Pilgrim Rock had been removed to the depth contemplated in the project. Ferry Reef, off Thirty-fourth street, had been reduced to a least depth of 24 feet; Heel Tap had been broken to 26 feet and dredged to 20.5 feet, and the least depths on Frying Pan and Pot Rock, respectively, were 18 and 22.8 feet at mean low water. Flood Rock and connecting reefs, covering 9 acres, had been broken to 30 feet, and 204,015 tons of débris had been removed. The least depth over Flood Rock, Hen and Chickens, and Gridiron was 20 feet at mean low water, and in the channel between Flood Rock and the Mill Rocks it was 18 feet at mean low water. Shell Reef, off Ninth street, had been removed to 18 feet depth, except at a few points. The reef off Sunken Meadow had been almost completely removed to 18 feet depth. A sea wall had been built by the Government to connect Great and Little Mill rocks, and another by the city authorities on Bread and Cheese. These results have been of the greatest value to navigation.

During the past fiscal year 31 tons of rock was removed from the reef off Sunken Meadow, removing shoal points and making the least depth on the reef 17.8 feet; the available funds were not sufficient to make the projected depth, 18 feet, over the entire reef.

It is impracticable to collect statistics showing the value of the commerce passing through Hell Gate, which consists mainly of the heavy coastwise traffic between New York and the New England States, and is carried in vessels that do not enter or clear at the custom-house.

July 1, 1897, balance unexpended	$13,956.14
June 30, 1898, amount expended during fiscal year	12,408.65
July 1, 1898, balance unexpended	1,547.49

Amount (estimated) required for completion of existing project	753,840.67
Amount that can be profitably expended in fiscal year ending June 30, 1900	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix F 2.)

3. *New York Harbor, New York.*—Before the improvement of the main entrance into New York Harbor was undertaken by the United States the least depth in mid-channel on the outer bar was 23.7 feet at mean low water, and about the same across three other shoals between the bar and deep water in the harbor. A large proportion of the commerce of the port, carried in vessels of great draft, could cross these shoals only at or near high water.

The project for the improvement of Gedney Channel was approved by the Secretary of War December, 1884, and extended to cover the whole of the main entrance to the harbor December, 1886. It provided for dredging a channel 1,000 feet wide and 30 feet deep at mean low water from deep water below the Narrows through the main ship and Gedney channels to deep water outside the bar.

The estimated cost was $1,490,000 for dredging 4,300,000 cubic yards. The actual amount dredged to October, 1891, when the work was approximately completed, was 4,875,079 cubic yards.

Up to June 30, 1897, $1,740,446.24 had been expended. The projected channel had been completed and maintained since 1891 by removing shoals and widening.

During the past fiscal year a shoal in the west side of the main ship channel was removed, and the channel through Northwest Shoal

was widened. A resurvey of the shoals and entrance channels was completed.

The last appropriation for completion of the project was made September 19, 1890. Subsequent appropriations have been applied to maintenance of the improvement.

The foreign exports and imports for the port of New York during the year ending December 31, 1897, were valued at $976,898,235, being an increase over that for 1886, before improvement was begun, of $136,621,546. The entire cost of the improvement to date is about 1⅓ per cent of the increase in foreign commerce since the improvement began, and is less than one-fifth of 1 per cent of the value of present foreign commerce.

July 1, 1897, balance unexpended	$72,978.28
Amount received since July 1, 1897	9,600.00
	82,578.28
June 30, 1898, amount expended during fiscal year	53,349.90
July 1, 1898, balance unexpended	29,228.38
July 1, 1898, outstanding liabilities	3,013.91
July 1, 1898, balance available	26,214.47
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	300,000.00

(See Appendix F 3.)

4. Removing sunken vessels or craft obstructing or endangering navigation.—1. The British steamship *Ailsa* sank in New York Harbor in the east side of the Narrows after a collision on February 29, 1896. July 1, 1897, a contract for removal was in progress. The wreck was removed to a clear depth of 40 feet below mean low water, the depth of the surrounding bottom, November 15, 1897. Under supplementary articles of agreement the materials recovered from the wreck were sold to the contractor for $1,000, to be deducted from the contract price. This made the net cost of removal $10,975.

2. The British steamship *Alvena* sank in New York Harbor, near the west end of Gedney Channel, after a collision on January 19, 1897. A contract for removal, at a cost of $36,000, was entered into, and the work of removal, begun in August, 1897, is now in progress and somewhat more than half completed. Under supplementary articles of agreement the materials recovered from the wreck were sold to the contractor for $2,200, to be deducted from the contract price, which will make the net cost of work of removal $33,800.

The total amount expended during the year on removal of wrecks is $14,924.14.

(See Appendix F 4.)

IMPROVEMENT OF RIVERS AND HARBORS IN VERMONT, OF NARROWS OF LAKE CHAMPLAIN, NEW YORK AND VERMONT, OF HUDSON RIVER, NEW YORK, AND HARBORS THEREON, AND OF RIVERS AND HARBORS IN NORTHEASTERN NEW JERSEY.

This district was in the charge of Lieut. Col. A. M. Miller, Corps of Engineers. Division Engineer, Brig. Gen. G. L. Gillespie, U. S. Volunteers, colonel, Corps of Engineers.

1. Channel between North and South Hero islands, Lake Champlain, Vermont.—In its original condition this channel was obstructed at its

west entrance by a bar through which the channel was but 40 feet wide and 7 feet deep, and at its east entrance by a bar through which the channel was 100 feet wide and 8 feet deep.

The project of August 11, 1888, was to dredge the channel at the two entrances to a width of 150 feet and depth of 10 feet.

At the close of the fiscal year ending June 30, 1896, $10,000 had been expended.

At that date there was a good channel at the east entrance of the depth and width prescribed in the project, but at the west entrance there was a troublesome bowlder in mid-channel and the channel was 1 to 2 feet shallower in the middle and 2 to 4 feet shallower at its edges and was 25 feet narrower than the project prescribed.

There have been no expenditures upon the improvement since September 30, 1889.

Amount (estimated) required for completion of existing project.....	$4,300.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	4,300.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

2. *Harbor at Burlington, Vermont.*—[This work was in the charge of Maj. W. S. Stanton, Corps of Engineers, until October 1, 1897.] This harbor is situated on the eastern shore of Lake Champlain. In its natural condition ample depth of water existed along its docks and wharves, which were, however, unprotected from the severe storms crossing the lake. The greatest exposure was from the prevalent northwesterly gales, which had a sweep of 15 miles obliquely across it.

The original project for improvement, adopted in 1836, consisted in forming an artificial harbor in front of the city by constructing a breakwater parallel with the shore, and about 1,000 feet distant from the docks and wharves. Work commenced in 1836 and continued at intervals until 1857, when 1,069 linear feet of breakwater had been completed.

In 1867 a Board of Engineers, convened to consider the location and construction of breakwater, recommended that the one previously constructed be extended northward 1,500 feet. Of this extension 831 linear feet was built, and, in addition, 617 linear feet was added at the south end, making its total length 2,517 feet at the close of the fiscal year 1874.

In June, 1874, a plan was adopted for an extension northward of the breakwater, for a farther distance of 2,000 feet, the cost being estimated at $340,000. (See Report of the Chief of Engineers for 1874, p. 275.)

In 1884 extensive repairs were begun to the portion of the breakwater built between 1836 and 1857.

By June 30, 1886, 3,560 linear feet of breakwater had been completed. On September 28 of that year a project was approved extending the breakwater 500 feet northerly and 1,000 feet southerly, keeping the line generally at a distance of from 800 to 1,000 feet from the line of the wharves.

August 24, 1894, a project was adopted which provided for replacing the decayed and dilapidated wooden superstructure of the breakwater with one of stone. (See Report of the Chief of Engineers for 1895, p. 3237.)

The amount expended on this improvement to the close of the fiscal year ending June 30, 1897, was $585,193.26. With this amount 4,163 linear feet of breakwater, varying in width from 24 to 36 feet, had been built, thereby affording protection to nearly all of the docks and wharves.

No extension was made to the breakwater during the fiscal year ending June 30, 1898; the money expended was applied to replacing 235 linear feet of decayed wooden superstructure, 34 feet wide, with one of stone, and in making minor repairs to other portions of the structure.

The maximum draft that can be carried to the docks and wharves on June 30, 1898, is 11 feet at mean low water.

To complete this improvement requires a further extension of the breakwater for a distance of 897 linear feet, and the replacing of 2,695 linear feet of timber superstructure with that of stone.

The freight handled by water during 1897 amounted to 109,180 tons, which is a decrease of 71,166 tons from 1895, and a decrease of 26,801 tons from 1896. The principal items of commerce at this port are coal, lumber, stone, and general merchandise.

July 1, 1897, balance unexpended	$10,367.81
June 30, 1898, amount expended during fiscal year	10,161.39
July 1, 1898, balance unexpended	206.42

Amount (estimated) required for completion of existing project	230,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	25,000.00

(See Appendix G 1.)

3. Otter Creek, Vermont.—[This work was in the charge of Maj. W. S. Stanton, Corps of Engineers, until October 1, 1897.] This creek flows into Lake Champlain from its eastern shore. In its natural condition the channel was narrow and tortuous in places, and the available depth from Vergennes to its mouth, a distance of 8 miles, was less than 6 feet.

The original project, adopted in 1872, proposed the formation of a channel 100 feet wide and 8 feet deep, from Lake Champlain to Vergennes, and also of a basin at this latter point at an estimated cost of $58,146. (See Report of the Chief of Engineers for 1872, p. 273.)

In 1882 the project was modified to provide for the removal of rock at steamboat landing, near Vergennes, which increased the cost to $73,748.40. (See Report of the Chief of Engineers for 1882, p. 711.)

The amount expended to June 30, 1897, was $61,401.52. At that date a channel 40 feet wide and 8 feet deep had been secured from Vergennes to the mouth.

No work was done during the present fiscal year owing to the lack of funds. The channel has shoaled about 1 foot.

The maximum depth that can be carried on June 30, 1898, is 7 feet at mean low water.

It is expected that, after completion of this work, occasional expenditures will be required for maintenance, owing to accretions that occur at some of the shoals during the season of freshets.

The commerce of this creek consists of coal, lumber, iron, kaolin, and general merchandise, and amounted in 1895 to 12,675 tons, in 1896 to 9,052 tons, and in 1897 to 7,680 tons.

July 1, 1897, balance unexpended	$8.48
June 30, 1898, amount expended during fiscal year	8.48

Amount (estimated) required for completion of existing project	12,248.00
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	5,000.00

(See Appendix G 2.)

4. Narrows of Lake Champlain, New York and Vermont.—[This work was in the charge of Maj. W. S. Stanton, Corps of Engineers, until Octo-

ber 1, 1897.] In its original condition the 15 miles of this waterway, extending from the northern terminus of Champlain Canal at Whitehall northerly to Bensons Landing, Vermont, had a very narrow and tortuous channel, not more than 9½ to 10 feet deep on the shoals at low water.

The original project, adopted in 1886, was to obtain a channel having a least width of 150 feet and depth of 12 feet at low water from the northern terminus of the Champlain Canal at Whitehall, N. Y., to deep water in Lake Champlain below Bensons Landing, Vermont, a distance of 15 miles, at an estimated cost of $80,000. (See Report of the Chief of Engineers for 1885, pp. 2312–2314.)

Work under this project was completed in September, 1889, at a little more than half its estimated cost, owing to the low prices paid for dredging.

In 1890 a supplemental project was prepared for widening and straightening the middle reaches of the channel at an estimated cost of $21,000. (See Report of the Chief of Engineers for 1890, p. 2884.) This project was adopted in 1892 and work completed under it in August, 1896.

To June 30, 1897, $63,484.49 had been expended. At that date the channel, which had previously been dredged to 12 feet, had shoaled in places, restricting the draft that vessels could carry through it to not exceeding 10 feet.

No work was done during the present fiscal year, no money being available for that purpose. No material change has occurred in the condition of the channel during the present fiscal year.

The maximum draft that can be carried on June 30, 1898, at mean low water is 10 feet.

Attention is invited to the recommendation contained in the report of the district officer in regard to the further needs of this improvement.

The tonnage passing through the Narrows amounted in 1895 to 826,880 tons, in 1896 to 604,800 tons, and in 1897 to 519,873 tons.

July 1, 1897, balance unexpended	$15.51
June 30, 1898, amount expended during fiscal year	15.51
Amount that can be profitably expended in fiscal year ending June 30, 1900, for restoration and maintenance of channel. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	12,000.00

(See Appendix G 3.)

5. *Hudson River, New York.*—[This work was in the charge of Brig. Gen. William Ludlow (now Maj. Gen.), U. S. Volunteers, lieutenant-colonel, Corps of Engineers, until October 1, 1897.] The portion of this river to which improvements have been applied is the stretch beginning at the head of navigation at Troy and extending downstream, at first to New Baltimore, a distance of 20 miles, and later to Coxsackie, a farther distance of 8 miles. In its natural condition the navigable depth of the channel between Troy and Albany was 4 feet, at mean low water, between Albany and New Baltimore 7½ feet, between New Baltimore and Coxsackie 11 feet, and below Coxsackie 12 feet or more, which was sufficient for purposes of navigation.

Prior to 1834, when the United States assumed charge of the improvement, work was carried on by the State of New York, and consisted in the construction of jetties and dredging, which resulted in no permanent improvement of the river.

A Board of Engineers was convened in 1834 to examine into the different projects presented, and to devise a plan, with estimates, for the improvement of the river. They recommended the construction of a system *of longitudinal dikes and occasional* dams, at an estimated

cost of $819,634.10. The sum of $370,000 was expended under this project.

In 1852 an additional project was adopted, which consisted in dredging and closing island chutes, under which $50,000 was expended.

From 1854 to 1866 no work was done by the General Government.

On June 24, 1866, a project was adopted for the improvement of the river between New Baltimore and Troy, a distance of 20 miles, giving a navigable channel of 11 feet, at mean low water, from New Baltimore to Albany, and 9 feet from Albany to Troy, to be secured by dikes and dredging, and estimated to cost $862,297.75.

This estimate was revised in 1867 to $984,304.47; again in 1882 to $1,062,304.47, and in 1886 to $1,078,304.47. In 1887 it was considered that $255,000 would still be required to complete the improvement, and in 1889 this estimate was increased $295,000 over and above prior appropriations, which made the total estimated cost of the work $1,423,538. The amount expended under this project was $1,247,940.29.

The river and harbor act of September 19, 1890, provided for the appointment of a Board of Engineer Officers, whose duty it was to thoroughly examine the obstructions in the Hudson River and report a project and estimate for its improvement. The project, contained in the Board's report of October 1, 1891, was adopted by Congress in 1892. It provided for maintaining old improvements and constructing new regulation works between Coxsackie and New Baltimore; also for deepening the entire reach under improvement so as to afford a channel 400 feet wide and 12 feet deep at mean low water, from Coxsackie to the foot of Broadway, Troy, and thence 300 feet wide and 12 feet deep to the State Dam. The estimated cost of the work was $2,447,906.56, provided the entire work be completed within five years.

A history of the improvement of this river is contained in the Report of the Chief of Engineers for 1885, page 677 et seq., and the report of the Board which formulated the present project can be found in the Report of the Chief of Engineers for 1892, page 750 et seq.

The total amount expended to June 30, 1897, was $3,479,274, of which $1,667,940.29 was under former projects, and $1,811,333.71 under the present one.

With this money 34,468 linear feet of new dikes and shore revetments had been completed, 5,509 linear feet of old dikes had been rebuilt, in lengths varying from 10 to 1,544 linear feet, 10,340 linear feet of old dikes had been refilled with rubblestone, 21,409 square yards of new paving had been laid under contract, 9,500 square yards of new paving had been laid, and 19,500 square yards of old paving had been repaired by hired labor; 3,632,269 cubic yards of sand, gravel, cobblestones, clay and bowlders, 144,090 tons of rock and 15,366.8 tons of sand covering rock, had been removed from the channel.

From Coxsackie to Albany there was a navigable channel not less than 11 feet at mean low water, with a minimum width of 100 feet. The general depth was 12 feet at mean low water, and the width from 50 to 400 feet. From Albany to the Lower Side-cut to the Erie Canal at Port Schuyler the channel was 12 feet deep at mean low water, and from 40 to 400 feet wide, except opposite Bath-on-the-Hudson, where it was only 10.5 feet deep at mean low water, for a width of 170 feet. No dredging having been done between the Lower Side-cut at Port Schuyler and the foot of Broadway, Troy, there was a navigable channel of only 8.5 feet depth, with a width of 150 feet.

The expenditure during the present fiscal year was applied to the construction of 2,254 linear feet of new dikes, rebuilding 2,094 linear

feet of old single-pile dikes, refilling with rubblestone 8,743 linear feet of old dikes, furnishing paving stone for repairing by hired labor 5,404 square yards of paving on old dikes and revetments; to dredging 530,473 cubic yards of material other than rock and sand covering rock from the channel at New Baltimore, Mulls Crossover, Castleton Bar, Bogart Light Shoal, in front of Albany, at Bath Crossover, and from the end of Patroons Island to the foot of Broadway, Troy; and to removal of 45,916.3 tons of rock, and 4,779.2 tons of sand covering rock, from the channel at Mulls Crossover, and between Breaker Island and the foot of Broadway, Troy; and to the removal of three wrecks from the channel of the river.

The results of the work done during the present fiscal year have been an increased width of channel at New Baltimore Bar from 100 to 300 feet, with a depth of 11 feet at mean low water; at Mulls Crossover no increase in the width of the channel 11.5 feet deep, but a channel 12 feet deep at mean low water 100 feet wide; at Bath Crossover an increased depth from 10.5 to 11.5 feet at mean low water for a width of 130 feet; opposite Breaker Island an increased width from 120 to 180 feet, with a depth of 12 feet at mean low water; at Van Buren Bar and Washington Bar an increased width from 120 to 190, and from 40 to 200 feet, respectively, with a depth of 12 feet at mean low water; opposite the Watervliet Arsenal an increased depth from 9 to 10.5 feet for a width of 250 feet, and to 11.5 feet for a width of 100 feet; and thence to the foot of Broadway, Troy, from 9 to 11 feet at mean low water for a width of 250 feet, with a channel of 12 feet depth and not less than 70 feet wide, as far as the foot of State street, Troy.

There has been an increase in the range of the tides at Troy of nearly 1 foot, and of the elevation of mean high water of about 0.3 of a foot.

The maximum draft that can be carried June 30, 1898, through from Coxsackie to Albany is 11 feet at mean low water, and, with the exception of New Baltimore Bar, there is a through channel of 11.5 feet. From Albany to the foot of Broadway, Troy, 11 feet at mean low water can be carried, and thence to the State Dam at Troy only 5.5 feet at mean low water, with a narrow and crooked channel.

Attention is invited to the report of the engineer officer in charge as to the further need of appropriations in order to complete this improvement, as provided for in the present project, thus affording additional facilities to the very large commercial interests of this important waterway. The revised estimate was submitted by the Secretary of War to Congress February 1, 1898.

The amount of commerce within the limits of the improvements now in progress is more than 4,000,000 tons annually. It consists principally of merchandise, grain, lumber, fuel, building material, and ice.

July 1, 1897, balance unexpended	$507,556.57
Amount appropriated by sundry civil act approved July 1, 1898	160,406.56
	667,963.13
June 30, 1898, amount expended during fiscal year	466,125.44
July 1, 1898, balance unexpended	201,837.69
July 1, 1898, outstanding liabilities	116,117.48
July 1, 1898, balance available	85,720.21
Amount that can be profitably expended in fiscal year ending June 30, 1900, including maintenance. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	100,000.00

(See Appendix G 4.)

6. Saugerties Harbor, New York.—[This work was in the charge of Brig. Gen. William Ludlow (now Maj. Gen.), U. S. Volunteers, lieutenant-colonel, Corps of Engineers, to October 1, 1897.] This harbor is situated at the mouth of Esopus Creek, which empties into the Hudson River on its west shore, about 100 miles above New York City. The creek is from 180 to 500 feet wide, and is navigable for a distance of about three-quarters of a mile above its mouth.

The natural depth in the creek was 7 feet or more at mean low water; the entrance, however, was obstructed by a broad shoal, on which there was an available depth of only about 3 feet. The mean rise and fall of the tides is about 4 feet.

A project for improvement was adopted in 1884, but was slightly modified before work began in 1887. It consisted in securing a channel 300 feet wide and 8 feet deep, at mean low water, by constructing parallel dikes and dredging between them; the estimated cost of the work being $52,000. (See Report of the Chief of Engineers for 1887, p. 662.)

The amount expended to June 30, 1897, was $54,158.30. The project was completed in 1892 at an actual cost of $42,000. Subsequent expenditures have been applied to maintenance.

No work was done during the past fiscal year, no funds being available for that purpose. There has been no appreciable change in the condition of the channel.

The maximum depth that can be carried on June 30, 1898, at mean low water is 8 feet.

The commerce of this harbor, consisting mainly of bluestone, coal, lumber, pulp wood, and general merchandise, amounted to 189,000 tons in 1895; to 120,300 tons in 1896, and to 51,000 tons in 1897.

July 1, 1897, balance unexpended	$341.70
June 30, 1898, amount expended during fiscal year	9.11
July 1, 1898, balance unexpended	332.59
Amount that can be profitably expended in fiscal year ending June 30, 1900 for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	2,500.00

(See Appendix G 5.)

7. Harbor at Rondout, New York.—[This work was in the charge of Brig. Gen. William Ludlow (now Maj. Gen.), U. S. Volunteers, lieutenant-colonel, Corps of Engineers, until October 1, 1897.] This harbor is situated at the mouth of Rondout Creek, which empties into the Hudson River on its west shore, 90 miles above New York City, and is the eastern terminus of the Delaware and Hudson Canal. The creek is a tidal stream for 3 miles above its mouth, with mean rise and fall of tide of about 4 feet.

In 1871 the available depth of water in the harbor was 7 feet at mean low water, the result of improvements made by private parties.

In 1872 a project for improvement was adopted which provided for securing a permanent channel 14 feet deep at mean low water, by constructing parallel dikes and dredging between them, at an estimated cost of $172,500. (See Report of the Chief of Engineers for 1872, p. 811.) This project was completed in 1880 at a total cost of $90,000; expenditures since then have been applied to maintenance.

The amount expended to June 30, 1897, was $114,208.14. At that date the channel had a depth of 14 feet and afforded navigation all the necessary facilities.

No work was done during the past fiscal year.

The maximum depth that can be carried on June 30, 1898, is 13 feet at mean low water.

The commerce of this harbor consists mainly of coal, cement, lime, bluestone, ice, and general merchandise. It amounted to 2,070,500 tons in 1895; to 2,333,050 tons in 1896, and to 2,330,000 tons in 1897.

July 1, 1897, balance unexpended	$4,791.86
June 30, 1898, amount expended during fiscal year	107.62
July 1, 1898, balance unexpended	4,684.24

(See Appendix G 6.)

8. *Harbor at Peekskill, New York.*—[This work was in the charge of Brig. Gen. William Ludlow (now Maj. Gen.), U. S. Volunteers, lieutenant-colonel, Corps of Engineers, until October 1, 1897.] This harbor is a prominent indentation upon the eastern shore of the Hudson River, about 45 miles above New York City. It measures approximately 1 square mile east of the 12-foot contour of the river, and the outlying flats, 3,500 feet wide, have a maximum depth over them of 5 feet at mean low water. A narrow channel, 6 feet deep at mean low water, follows the shore from north to south past the town docks, which enables steamboats and small craft to transport by water a part of the commerce originating at the town.

The original project for this improvement, adopted by the river and harbor act of June 6, 1896, consisted in widening the channel along the wharf front to 100 feet and deepening it to 10 feet, also in extending it north and south until the deep-water channel in the Hudson River was reached. The estimated cost was $50,000.

The amount expended to June 30, 1897 ($9,796.30), was applied to dredging a channel 100 feet wide and 9 feet deep at mean low water along the wharf front and extending it southward to the deep-water channel of the Hudson River, also in dredging two turning basins in front of the center and lower wharves.

No work was done during the fiscal year owing to lack of funds.

The maximum draft that can be carried to the wharves on June 30, 1898, is 9 feet at mean low water.

The commerce of this harbor consists of general merchandise, building material, iron ore and manufactured articles, coal and wood, lumber, and molding sand. It amounted to 522,955 tons in 1894; to 546,000 tons in 1896, and to 404,300 tons in 1897.

July 1, 1897, balance unexpended	$203.70
June 30, 1898, amount expended during fiscal year	4.27
July 1, 1898, balance unexpended	199.43
Amount (estimated) required for completion of existing project	40,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix G 7.)

9. *Passaic River, New Jersey.*—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until October 1, 1897.] This river is a stream of considerable size rising among the highlands in the northern part of New Jersey and flowing in a general easterly and southerly course into Newark Bay. It is navigable from its mouth to Passaic, a distance of about 16 miles. In its natural condition the navigable depth to Newark was about 7 feet at mean low water; from

Newark to Passaic it was about 3 feet. The rise of the tide at the mouth is 4.7 feet, and at Passaic it is 3.3 feet.

The first project for improvement, adopted by the river and harbor act of June 10, 1872, was for providing a channel from Newark to Passaic from 6 to 7½ feet deep, and from 50 to 200 feet wide, the cost being estimated at $123,924.

A subsequent project for improving the river below Newark was authorized by the river and harbor act of June 14, 1880, at an estimated cost of $353,875. It proposed a channel 200 feet wide and 10 feet deep at mean low water up to Center Street Bridge, Newark.

The two projects were consolidated by the river and harbor act of July 13, 1892, the estimated cost of the improvement being $547,697.

The amount expended to June 30, 1897, $452,988.53, was applied to constructing several small dikes in the upper part of the river; also 6,205 linear feet of dikes at the head of Newark Bay. The channels had all been dredged to the required width and depth, except over one of the bars above Newark, but had again shoaled in some places as much as from 1 to 2 feet.

No work was done during the past year owing to lack of funds.

The maximum depth that can be carried on June 30, 1898, to Newark is 9.5 feet, and to Passaic 4 feet, both at mean low water.

The commerce of this river, consisting mainly of building materials, iron ore, fertilizers, coal, and general merchandise, amounted to 1,258,966 tons in 1895; to 1,243,613 tons in 1896, and to 1,370,724 tons in 1897.

July 1, 1897, balance unexpended	$361.47
June 30, 1898, amount expended during fiscal year	323.66
July 1, 1898, balance unexpended	37.81
Amount (estimated) required for completion of existing project	94,347.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix G 8.)

10. Channel between Staten Island and New Jersey.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until October 1, 1897.] This channel is an inland waterway about 17 miles long, connecting New York Harbor with Raritan Bay. It consists of the Kill van Kull, connecting the upper bay with Newark Bay, and the Arthur Kill, connecting Newark Bay with Raritan Bay.

The natural depth through the channel was 15 feet or more at mean low water, except for a distance of about 1¾ miles in Newark Bay, where there was a shoal with a crooked channel 9½ feet deep. The mean rise of tide is about 5 feet.

The first project, adopted by the river and harbor act of June 23, 1874, was for making a channel, from 14 to 16 feet deep, through this shoal, at an estimated cost of $443,211. The only work done under it was building 2,237 linear feet of diking, at a cost of $50,000.

A second project was adopted in 1880, which, with subsequent modifications, consisted in dredging a channel through the shoal 400 feet wide and 14 feet deep at mean low water, the cost being estimated at $210,000.

The river and harbor act of June 3, 1896, extended the project to include the dredging of a channel in Lemon Creek, on Staten Island, on which $5,000 was to be expended.

Up to June 30, 1897, $232,970.31 had been expended on this improvement. The channel was dredged to a depth of 14 feet, mean low water, *the minimum width being 250 feet.*

A channel 8 feet deep at mean high water and 50 feet wide was made from Princess Bay to the entrance of Lemon Creek, and thence up to the drawbridge; above the bridge the channel was made 8 feet deep and 35 feet wide for a distance of 1,120 feet.

No work was done during the past year owing to lack of funds.

The maximum draft that can be carried June 30, 1898, through the Staten Island channel is 14 feet at mean low water, and in Lemon Creek it is 2.5 feet at mean low water and 7.4 feet at high water.

The annual amount of freight carried through this waterway is about 9,000,000 tons, and consists of oil, coal, and miscellaneous freights from the railroad termini; brick, clay, and fertilizers from manufacturers along the waterway, together with the through traffic between Raritan Bay, Raritan and Elizabeth rivers, Woodbridge and Richmond creeks, and New York Harbor.

July 1, 1897, balance unexpended	$29.69
June 30, 1898, amount expended during fiscal year	29.69
Amount (estimated) required for completion of existing project	32,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix G 9.)

11. Elizabeth River, New Jersey.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until October 1, 1897.] This is a small creek in the eastern part of New Jersey, which discharges into the Arthur Kill at Elizabethport. Its width varied from 50 to 90 feet, and it had a high-water depth of 4 feet at the head of navigation at Broad street, Elizabeth, 2⅝ miles above its mouth. The mean rise of tide at the mouth was 4.7 feet, and at Broad street, Elizabeth, 3.4 feet.

The project, authorized by the river and harbor act of March 3, 1879, consisted in improving the river by dredging a channel 60 feet wide and 7 feet deep at mean high water to the head of navigation, at an estimated cost of $25,530, which was afterwards increased to $43,160.

With the amount expended to June 30, 1897, $39,970.91, a channel 7 feet deep and from 30 to 60 feet wide had been dredged to Broad street, Elizabeth. In order to maintain this channel, it has had to be redredged during several successive seasons.

The amount expended during the past fiscal year was applied to redredging the channel in the shoal section of the river between South and Summer streets, Elizabeth, to a depth of 7 feet at mean high water.

The maximum draft that can be carried to Broad street, Elizabeth, on June 30, 1898, is 1.6 feet at mean low water and 5 feet at high water.

The commerce of this river consists of coal, building material, and miscellaneous freights. It amounted to 21,650 tons in 1895, 36,066 tons in 1896, and 28,865 tons in 1897.

July 1, 1897, balance unexpended	$3,189.09
June 30, 1898, amount expended during fiscal year	3,189.09

(See Appendix G 10.)

12. Raritan River, New Jersey.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until October 1, 1897.] This river is a moderate sized stream flowing through the central part of the State of New Jersey and emptying into the Raritan Bay at Perth Amboy. It is navigable to New Brunswick, N. J., a distance of 12 miles, where it is the eastern terminus of the Delaware and Raritan Canal. The mean rise of tide at the mouth is 5.1 feet, and at New Brunswick it is 5.56 feet.

In its natural state the channel to New Brunswick was obstructed by several extensive shoals, on which the depth was from 6½ to 8½ feet at mean low water.

The project for improvement, adopted by the river and harbor act of June 18, 1878, provided for a channel 200 feet wide and 10 feet deep at mean low water from the mouth to the Delaware and Raritan Canal terminus at New Brunswick, to be obtained by dredging, diking, and rock excavation, the cost being estimated at $2,093,662.

The amount expended to June 30, 1897, was $639,333.49. With this money four dikes had been completed and the fifth and last more than half finished. A channel of the full depth of 10 feet at mean low water had been made to within 700 feet of the canal terminus, the lower 8½ miles being 200 feet and the balance 100 feet wide.

During the past fiscal year 3,625 tons of rock was broken up and 5,070 tons of broken rock removed, thereby extending the 10-foot channel, 100 feet wide, to within 500 feet of the canal terminus. The rock was utilized in completing unfinished portions of the dike "C" at the middle ground, which is now 2,320 feet long and built up to a height of about 3 feet above mean high water.

The maximum draft that can be carried to New Brunswick on June 30, 1898, is 6 feet at mean low water.

The commerce of this river consists principally of coal, ores, lumber, building material, and general merchandise. It amounted in 1895 to 975,101 tons, in 1896 to 1,136,974 tons, and in 1897 to 1,218,752 tons.

July 1, 1897, balance unexpended	$11,916.51
June 30, 1898, amount expended during fiscal year	11,916.51
Amount (estimated) required for completion of existing project	1,442,412.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix G 11.)

13. South River, New Jersey.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until October 1, 1897.] This is a small stream in the central part of New Jersey, which discharges into the Raritan River about 8 miles above its mouth.

A private canal about three-quarters of a mile long had been dredged from near Washington, on the South River, to Sayreville, on the Raritan River, which shortened the sailing course about 2 miles.

The depth in the canal was about 3.5 feet, and in the river about 2.5 feet as far as Old Bridge, at the head of navigation, 6.3 miles above the canal. The mean rise of tide at the canal is 5.34 feet and at Old Bridge 4.57 feet.

The first project, adopted by the river and harbor act of March 3, 1871, proposed dredging a channel 6 feet deep at mean low water up to the Washington wharves, at an estimated cost of $13,653. This was completed in 1874, at a cost of $20,000.

The present project, authorized by the river and harbor act of June 14, 1880, provided for correcting the canal outlet and for obtaining, by dredging and diking, a channel 100 feet wide and 8 feet deep to Washington, 1.5 miles above the mouth; thence 6 feet deep to Bissetts, 3.7 miles above the mouth; thence 4 feet deep to Old Bridge, 6.3 miles above the mouth, at the head of navigation. The cost was estimated at $194,695, but was reduced in 1892 to $176,975.

The total amount expended to June 30, 1897, under the present project was $87,417.20. The mouth of the canal has been rectified, and

six dikes have been built below Washington. An 8-foot channel, having a minimum width of 50 feet, has been dredged to Washington, and parts of the channel above there have been deepened to 6 feet.

No work was done during the past year, owing to lack of funds.

The maximum draft that can be carried to Washington on June 30, 1898, is 4½ feet at mean low water.

Large brickyards established along the banks of this river give it a commercial importance out of proportion to its size.

The commerce consists principally of brick, clay, coal, and general merchandise, and amounted in 1895 to 177,794 tons; in 1896 to 216,783 tons, and in 1897 to 308,563 tons.

July 1, 1897, balance unexpended	$582.80
June 30, 1898, amount expended during fiscal year	60.65
July 1, 1898, balance unexpended	522.15

Amount (estimated) required for completion of existing project	88,975.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	7,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix G 12.)

14. Raritan Bay, New Jersey.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until October 8, 1897.] This bay is a large body of water lying between the southern end of Staten Island and the New Jersey shore. Its greatest width north and south is about 5 miles, and its greatest length east and west is about 7 miles. The Raritan River empties into it at its west end between Perth Amboy and South Amboy, and the Arthur Kill, or Staten Island Sound, extends northward, connecting it with Newark Bay.

This bay had naturally a fairly straight channel, 11 feet deep at mean low water, to South Amboy. The line of the deepest water, however, followed the Staten Island shore from Perth Amboy to Seguine Point, where it was separated from deep water in the eastern part of the bay by a shoal 1.5 miles broad, with a minimum depth of 14.5 feet. The mean rise of tide in the bay is 5 feet.

The river and harbor act of March 3, 1881, authorized a project for making a 21-foot channel, 300 feet wide, from Seguine Point to deep water in the bay, at a cost of $126,000. This amount was subsequently increased to $165,000 to provide for a channel of the same dimensions through the shoals off Wards Point. The act of September 19, 1890, extended the project to include a 15-foot channel, 300 feet wide, from South Amboy to deep water near Great Beds Light, the cost of the improvement being increased to $357,875. The act of June 3, 1896, again amended the project so as to make this latter channel 21 feet deep instead of 15, at an additional cost of $150,000.

The present project, therefore, consists in dredging 21-foot channels at mean low water, 300 feet wide, from Seguine Point to deep water in the bay, through two shoals opposite Wards Point, and from South Amboy to deep water near Great Beds Light, at a total estimated cost of $507,875.

The amount expended to June 30, 1897, was $373,383.96. The Seguine Point channel had been dredged and redredged to a depth of 21 feet for a width of from 100 to 300 feet, but had shoaled to a depth of from 18 to 19 feet for a distance of 100 feet on either side. The South Amboy channel had been dredged to a depth of 15 feet for a width of 300 feet, and redredged to a depth of 21 feet for a width of from 100 to 150 feet.

The available funds not being sufficient for continuing the improvement, no work of dredging was done during the year, but certain materials thrown from vessels stranded on the Great Beds were found to obstruct the channel; these were removed.

The maximum draft that can be carried June 30, 1898, through the Seguine Point and Wards Point channels is 18 feet at mean low water; through the South Amboy channel it is 13 feet at mean low water.

The commerce of the bay consists mainly of coal, brick, manufactures, and general merchandise. It amounted in 1895 to 3,822,462 tons; in 1896 to 4,629,514 tons, and in 1897 to 4,852,075 tons.

July 1, 1897, balance unexpended	$4,116.04
June 30, 1898, amount expended during fiscal year	962.40
July 1, 1898, balance unexpended	3,153.64

Amount (estimated) required for completion of existing project	130,375.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix G 13.)

15. Matawan Creek, New Jersey.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until October 1, 1897.] This creek is a small tidal stream in the eastern part of New Jersey, which discharges into Raritan Bay at Keyport Harbor. It is navigable up to the bridge of the New York and Long Branch Railroad, about 1⅞ miles above its mouth.

In its natural condition the mouth was obstructed by a mud flat, through which a narrow and crooked 3-foot channel existed. Above this flat there was a 4-foot channel for a mile, and beyond a narrow 3½-foot channel extending nearly up to the head of navigation at Matawan. The rise of tide is 4.9 feet.

The river and harbor act of March 3, 1881, authorized a project for improving this stream by dredging a 4-foot channel, 100 feet wide, from the mouth to Winkson Creek, about 1 mile, and thence 75 feet wide to the railroad bridge at Matawan, the estimated cost being $33,120.

The amount expended on this work to June 30, 1897, was $35,986.14. A channel 4 feet deep at mean low water had been made to the Matawan Steamboat Dock, the width varying from 40 to 100 feet.

The amount expended during the past year was applied to redredging the channel to a depth of 4 feet, and width from 30 to 60 feet, from Winkson Creek to the upper dock at Matawan.

The maximum draft that can be carried June 30, 1898, to Matawan is 4 feet at mean low water.

Appropriations equaling the estimated cost of this work were made in 1892. The project, however, has not been completed, owing to the necessity of redredging where shoaling has occurred. It is estimated that a channel sufficient for the requirements of the local commerce can be maintained at an average annual cost of $3,000.

The commerce of this creek, consisting mainly of farm produce, fertilizers, brick, coal, and miscellaneous freight, amounted in 1895 to 338,025 tons; in 1896 to 435,000 tons, and in 1897 to 415,000 tons.

July 1, 1897, balance unexpended	$3,133.86
June 30, 1898, amount expended during fiscal year	3,133.86

Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement	3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix G 14.)

16. Keyport Harbor, New Jersey.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, to October 1, 1897.] This harbor consists of a bay about 1 mile broad, on the south shore of Raritan Bay.

There was naturally no distinct channel in the harbor, the available depth to the wharves being less than 4 feet at mean low water. A 6-foot channel had been dredged at private expense before the United States assumed charge of the improvement, but it had shoaled again to 5 feet. The range of the tide is 4.9 feet.

The river and harbor act of August 2, 1882, adopted a project for dredging an 8-foot channel, 200 feet wide, from Raritan Bay to the steamboat dock, at a cost of $40,475.

The amount expended to June 30, 1897, was $42,758.61. An 8-foot channel, 160 to 200 feet wide, had been dredged in 1883 from the Keyport wharves to Raritan Bay. No further work having been done until 1890, the channel had almost filled up. Since then it has been redredged to 8 feet, with a minimum width of 75 feet.

No work was done during the past year, owing to lack of funds.

The maximum draft that can be carried June 30, 1898, to the Keyport wharves is 5 feet at mean low water.

On account of the shoaling since the beginning of work the channel has not been completed to the required dimensions, although more than the estimated cost of the improvement has been appropriated and expended. This work is not of a permanent character. It is estimated that a channel sufficient for the requirements of local commerce can be maintained at an average annual cost of $5,000.

The commerce of this harbor consists mainly of farm produce, fertilizers, brick, coal, and miscellaneous freight, amounting to 434,625 tons in 1895, to 540,200 tons in 1896, and to 524,100 tons in 1897.

July 1, 1897, balance unexpended	$216.39
June 30, 1898, amount expended during fiscal year	216.39
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	5,000.00

(See Appendix G 15.)

17. Shoal Harbor and Compton Creek, New Jersey.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, to October 1, 1897.] This harbor is on the south shore of Raritan Bay, 5 miles from Sandy Hook; Compton Creek is a narrow stream emptying into it. The natural harbor is inside the mouth of the creek, where the depth is from 3 to 6 feet at mean low tide. The creek is navigable for one-quarter of a mile above its mouth, where it is crossed by a highway bridge without a draw.

The entrance to this harbor was obstructed by a broad flat shoal, on which there was a depth of less than 1 foot at mean low tide, the distance between the deep water in the creek and the 4-foot depth in the bay being about one-half mile. The mean rise of tide is 4.5 feet.

A project for improvement, authorized by the river and harbor act of September 19, 1890, proposed a channel 4 feet deep at mean low water, connecting Compton Creek with Raritan Bay. It was to be 150 feet wide in the bay and 75 feet wide in and near the mouth of the creek, which was to be protected by a dike if necessary. The estimated cost of the work was $64,140.

The amount expended to June 30, 1897, was $15,941.12, which resulted in a channel 75 feet wide and 4 feet deep from Compton Creek to the 2-foot contour in Raritan Bay, a distance of 2,080 feet.

No work was done during the past fiscal year, owing to lack of funds.

The maximum draft that can be carried June 30, 1898, in the channel connecting Compton Creek with Raritan Bay is 1.7 feet at mean low water.

The commerce of this locality consists of farm and fishing products, fertilizers, and general merchandise, and amounted in 1895 to 152,000 tons, in 1896 to 167,000 tons, and in 1897 to 184,000 tons.

July 1, 1897, balance unexpended	$58.88
June 30, 1898, amount expended during fiscal year	58.88
Amount (estimated) required for completion of existing project	48,130.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	8,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix G 16.)

18. Shrewsbury River, New Jersey.—[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, to October 1, 1897.] This river is a large tidal basin in the eastern part of New Jersey, and consists of two bays, each having an area of about 3 square miles, and known as the North Branch, or Navesink River, and the South Branch. A channel, called the Main Stem, unites the two branches at their eastern ends, and extends northwardly to the southeast end of Sandy Hook Bay.

Before any improvement was begun by the United States the available depth to Oceanic, on the North Branch, 5 miles above the mouth, was 3.5 feet; to Branchport, on the South Branch, 9 miles above the mouth, it was 2.5 feet. The mean rise of tide at the outer bar is 5 feet, at Highlands Bridge 3 feet, and at Seabright Bridge 1.3 feet.

A project was adopted by the river and harbor act of March 3, 1871, for dredging 6-foot channels through the shoal places in both branches of the river. This was completed in 1873 at a cost of $19,000. The channels, however, soon filled up after suspension of work.

The present plan of improvement, adopted by the river and harbor act of March 3, 1879, provided for making 6-foot channels at mean low water, with widths from 150 to 300 feet, through the shoals in the main stem and both branches, by means of dredging and diking, at an estimated cost of $142,086. Owing to the necessity of frequent redredging, and to the fact that prices were higher than anticipated, the estimated cost was increased to $234,062.

In view of the fact that during the winter of 1896–97 the sea broke through the Sandy Hook Peninsula, nearly opposite Island Beach, carrying sand into the river and filling up the improved channel to above the ordinary high-water line, and leaving a secondary inlet about 6 feet deep at mean low water, between the river and the ocean, the navigation of which was prevented by an outer bar and by the Government railroad trestle to Sandy Hook, authority was granted March 1, 1897, to modify the project so as to temporarily provide navigation with a 6-foot channel west of Island Beach until the inlet was closed and it again became desirable to continue the improvement of the east channel.

The amount expended on the present project to June 30, 1897, was $226,253.01. Nine dikes had been built, and 6-foot channels having widths of from 60 to 200 feet, had been dredged through the shoals in the main stem and branches. These channels not being permanent, necessitated redredging at several localities more than once. A channel 2,400 feet long, 100 feet wide, and 6 feet deep was also dredged west of Island Beach, thereby restoring navigation for the season of 1897.

The expenditure during the past year was applied to increasing the width of the channel in the South Branch, above Seabright, from 50 to 110 feet; in building clumps of fender piles along the stone dike above Seabright and the dike at the river mouth, and in removing the timberwork of an old dike obstructing navigation at Upper Rocky Point on the North Branch.

The maximum draft that can be carried June 30, 1898, through the main stem of the river by way of the cut west of Island Beach is 4 feet at mean low water; in the North Branch 6 feet, and in the South Branch 4 feet, both at mean low water.

Although the estimated cost of the work has been appropriated and expended, it has not been possible to complete the improvement, owing to the frequent necessity of redredging several of the shoals and of making a new channel west of Island Beach in order to prevent stoppage of traffic. The channel east of Island Beach can not be reopened until the inlet in the Sandy Hook Peninsula has been permanently closed. It is estimated that channels sufficient for the requirements of local commerce can be maintained at an average annual cost of $10,000.

The commerce of this river consists mainly of coal, farm products, fertilizers, and general merchandise, and amounted in 1895 to 630,100 tons, in 1896 to 868,130 tons, and in 1897 to 896,600 tons. The passenger traffic is important; the number carried in 1897 is estimated at 400,000.

July 1, 1897, balance unexpended	$7,746.99
June 30, 1898, amount expended during fiscal year	7,746.99
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	10,000.00

(See Appendix G 17.)

19. Manasquan River, New Jersey.—This is a small stream in the eastern part of New Jersey, which empties into the Atlantic Ocean about 26 miles south of Sandy Hook.

In its natural condition the stream had a depth of from 4 to 6 feet, at mean low water, for several miles above its mouth, but was obstructed at its outlet into the ocean by a sand spit which deflected the stream into a channel parallel with the beach, communicating with the ocean across shifting sand bars, on which the depth did not exceed 1.5 feet at mean low water. In severe storms this channel was sometimes closed by sand, remaining so until sufficient fresh water had accumulated in the river to force a new outlet. The mean range of tide is 2.4 feet.

A project for improvement, adopted by the river and harbor act of March 3, 1879, contemplated obtaining a permanent outlet for the river nearly at right angles to the shore, with a depth of 6 feet at mean low water, also in dredging a channel in the lower river to the same depth. The estimated cost was $52,120.

The amount expended under this project to June 30, 1897, was $39,000. With this money two jetties had been constructed, but neither having been completed to full length, no permanent improvement was accomplished. No further appropriations were made for this work from 1882 to 1890.

The river and harbor act of September 19, 1890, appropriated $2,000, to be expended in the removal of obstructions placed by the Government at the mouth of the river, if, in the discretion of the Secretary of

War, the same should be done. The removal of the obstructions alluded to was deemed unnecessary by the local engineer officer in charge, therefore no expenditure was made of these funds.

At the request of interested parties a survey of this locality was made during the past fiscal year, with a view to devising some project which would afford permanent improvement at this locality. This project is contained in the report of the local engineer officer, to which attention is invited.

The maximum draft that can be carried June 30, 1898, in this river is 2 feet at mean low water.

The commerce of the river amounted to practically nothing during 1897.

July 1, 1897, balance unexpended	$2,000.00
June 30, 1898, amount expended during fiscal year	300.00
July 1, 1898, balance unexpended	1,700.00
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	10,000.00

(See Appendix G 18.)

20. Removing sunken vessels or craft obstructing or endangering navigation.—1. The wreck of an unknown canal boat lodged in the channel of the Arthur Kill, New York and New Jersey, near Woodbridge Creek, in September, 1897, forming an obstruction to navigation.

The wreck was removed and disposed of during November, 1897.

2. The condemned canal boat *Harwick* drifted into Newark Bay, New Jersey, and lodged near the channel opposite Bergen Point, New Jersey, in December, 1897, was abandoned, and became an obstruction to navigation.

The wreck was broken up and removed during February, 1898.

The total amount expended during the year on removal of wrecks was $500.

(See Appendix G 19.)

IMPROVEMENT OF DELAWARE RIVER AND BAY AND OF WATERS TRIBUTARY THERETO, NEW JERSEY, PENNSYLVANIA, AND DELAWARE, AND OF RIVERS AND HARBORS IN SOUTHERN NEW JERSEY.

This district was in the charge of Lieut. Col. C. W. Raymond, Corps of Engineers, having under his immediate orders Maj. Spencer Cosby, U. S. Volunteers, first lieutenant, Corps of Engineers, the entire year, and additional Second Lieut. Sherwood A. Cheney, Corps of Engineers, from September 30, 1897, to April 12, 1898.

1. Delaware River, New Jersey and Pennsylvania.—Trenton, the head of natural navigation on the Delaware River, is about 30 miles above the upper part of the port of Philadelphia. In its original condition this part of the river was obstructed by shoals at the following localities: Between Bordentown and Trenton, a distance of about 5 miles, a narrow and circuitous channel existed, which carried from 3 to 6 feet at mean low water. At Kinkora Bar, about 9 miles below Trenton, a shoal carrying 7½ feet, and at Five-mile Bar, at the upper part of Philadelphia, a shoal across the Pennsylvania channel, carrying only 3 to 4 feet at mean low water, there being, however, 13 feet of water past Five-mile Bar in the New Jersey channel passing south of Petty Island.

Below Philadelphia the river in its original condition presented

obstructions at Mifflin Bar, which reduced the depth at mean low water to 17 feet; at Schooner Ledge and Cherry Island Flats to 18 feet; at Bulkhead Shoal and Dan Baker Shoal to about 20 feet; and at Duck Creek Flats to about 20 feet. In that part of the Delaware River between Trenton, N. J., and Bridesburg, Pa., efforts in the past have been directed toward relieving commerce from the obstructions which exist in the upper 9 miles of the river and deepening the channel across Kinkora Bar.

Previous to 1885 the efforts to improve the river between Philadelphia and the bay were confined to dredging, except at Schooner Ledge, where solid rock was removed, under appropriations for special localities, and also under general appropriations for the Delaware River below Bridesburg.

A Board of Engineers, convened by direction of the Secretary of War for the purpose of considering the subject of the permanent improvement of Delaware River and Bay, recommended, under date of January 23, 1885, the formation of a ship channel from a point opposite Philadelphia and about midway between the American Shipbuilding Company's yard and the Gas Trust wharf to deep water in Delaware Bay, having a least width of 600 feet and a depth of 26 feet at mean low water. The formation of such a channel was to be obtained, except at Schooner Ledge, where rock would require to be removed, by regulating the tidal flow by means of dikes, with recourse to dredging where necessary as an aid to such contracting and regulating works.

The estimated cost of obtaining a channel of the above dimensions was about $2,425,000, which covers the estimated cost of the permanent improvement of the Delaware River between the upper part of Philadelphia and deep water in the bay. The annual cost of maintenance was estimated at 10 per cent of the original cost for dredging and 1 per cent of the original cost for dikes. This estimate of cost does not include the improvement of Philadelphia Harbor, which is a separate project.

The entire amount expended on the improvement of the Delaware River from 1836 to June 30, 1897, under appropriations for special localities and the general river was $2,463,909.77, of which $119,479.31 was expended on that part of the river between Trenton and Philadelphia. As the result of this expenditure, there was at the latter date a channel of navigable width and 6 feet deep at mean low water through Perriwig Bar; a channel of navigable width and 7 feet deep in the eastern channel of the river at Bordentown; a channel through Kinkora Bar 8½ feet deep; a channel through Five-mile Bar over the whole width 25 feet deep; a channel 600 feet wide and 26 feet deep through the shoal areas at Port Richmond; a channel 600 feet wide and 26 feet deep at Otis Street wharf; a channel through Mifflin Bar about 23.4 feet deep; a channel through Schooner Ledge 24 feet deep, except over a small area where the depth was 23 feet; a channel through Cherry Island Flats with a minimum depth of 26 feet; and a channel through Pennsville Shoals and Bulkhead Bar 26 feet deep.

The channel between Philadelphia and Camden, across Smith Island Bar, had been improved by the formation of a dredged cut protected by revetments, so as to give a channel 100 feet wide with a minimum depth of 6 feet at mean low water. The revetment has been removed in the work of improving the harbor of Philadelphia.

During the fiscal year ending June 30, 1897, the sum of $80,738.79 was expended in surveys and examinations, in dike construction, and

in dredging at Cherry Island Flats, Dan Baker Shoal, and Duck Creek Flats. The sum of $54,350.35 was expended in adjusting the losses of contractors resulting from the annulment of the contract for the construction and repair of dikes at Reedy Island and Liston Point, in consequence of the provisions of the river and harbor act of June 3, 1896, and the sum of $2,428.40 was expended in rebuilding and enlarging the dike at Fort Mifflin, in accordance with provisions in the river and harbor act of June 3, 1896.

During the past fiscal year the sum of $304,550.04 was expended in surveys and examinations and in dredging at Perriwig Bar, Cherry Island Flats, Dan Baker Shoal, Duck Creek Flats, and between deep water above Dan Baker Shoal and deep water below Pea Patch Island (off Salem Cove), and repair of banks at Fort Mifflin.

The changes during the past fiscal year are summarized as follows:

The channel through Perriwig Bar has been dredged to a depth of 6 feet at mean low water over a width of 200 feet; the channel through Five-mile Bar has a depth of 26 feet at mean low water over its entire width.

At Cherry Island Flats the channel has been dredged to a minimum depth of 26 feet over a width of 220 to 265 feet and a length of 13,600 feet. At Bulkhead Bar the minimum depth is 26 feet. Dredging is in progress through the shoal between deep water above Dan Baker Shoal and deep water below Pea Patch Island (off Salem Cove), to secure a channel 26 feet deep at mean low water over a width of 400 feet.

At Dan Baker Shoal the channel has been dredged to a depth of 26 feet at mean low water over a width of from 300 to 500 feet, and at Duck Creek Flats a similar channel has been dredged over a width of 400 feet.

The dike at Fort Mifflin has been reconstructed and repaired along the Delaware River front for a distance of 280 feet.

Under authorities granted by the Secretary of War, the city of Philadelphia is now improving the channel at Greenwich Point, Mifflin Bar, and Schooner Ledge. In view of the work thus provided for by the city and the low prices for dredging obtained in the recent contracts, the estimated cost of completing the improvement from Marcushook ice piers to deep water in Delaware Bay, in accordance with the approved project, has been reduced from $805,000 to $300,000, this estimate being based on the assumption that the city of Philadelphia will complete the channel from the city to the Marcushook ice piers.

The benefits to navigation resulting from the improvement have been great. Previous to the improvement vessels of deep draft were compelled to utilize the high water of two tides in order to ascend the river to Philadelphia. They can now make the whole trip in a single tide.

For 1890 the total foreign freight movement of the Delaware River was estimated at 2,922,994 tons, and the total domestic freight movement at 8,433,276 tons. For 1897 the total foreign freight movement is estimated at 3,782,759 tons, and the total domestic freight movement at 14,240,729 tons. There has been an important increase in the foreign freight movement, most noticeable in the imports of iron ore and sugar and the exports of grain and oil, attributable in a great measure to the improvements of the river and harbor admitting deeper draft vessels. As the greater part of the domestic freight is carried in vessels of moderate draft, the increase in its movement can not be considered as due to the improvement of the river. The foreign freight movement for 1897 was 755,956 tons in excess of the same movement

for 1896, while the domestic freight movement for the same period was 1,999,167 tons in excess of that for 1896. The total value of the freight moved upon the river in 1897 is estimated at $627,516,986.

July 1, 1897, balance unexpended		$508,090.23
June 30, 1898, amount expended during fiscal year		304,550.04
July 1, 1898, balance unexpended		203,540.19
July 1, 1898, outstanding liabilities	$47,685.73	
July 1, 1898, amount covered by uncompleted contracts	10,317.27	
		58,003.00
July 1, 1898, balance available		145,537.19

Amount (estimated) required for completion of existing project	300,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	300,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H 1.)

2. *Harbor between Philadelphia, Pa., and Camden, N. J.*—At the time of adoption of the present project the islands in the Delaware River between Philadelphia and Camden compelled the flood and ebb currents to pursue different paths, narrowed the existing channels, and prevented the extension of wharves necessary for the purposes of commerce. The plan of improvement originally adopted by Congress provides for the removal of Smith and Windmill islands and a part of Petty Island, and the formation of a channel of ample depth and about 2,000 feet in width from Kaighn Point to Fishers Point. The project contemplates the advance of wharves and bulkheads on both the Philadelphia and Camden shores during the progress of the work. The excavation is to be done by the General Government. The advance of wharves and bulkheads is under the control of the local authorities and private owners, a portion of the material to be removed by the Government being considered available for the necessary filling. The estimated cost of the work to be done by the United States, exclusive of the cost of the islands, was $3,500,000.

The project was modified by Congress in the sundry civil act approved March 3, 1891, by authorizing a change in the line limiting the excavation on Petty Island, and by requiring that all material removed under appropriations made to that date should be deposited and spread on League Island. The latter requirement was revoked by Congress in the river and harbor act approved July 13, 1892, which provides that the material removed may be deposited in any place or places approved by the engineer officer in charge of the work.

The amount expended under the project to June 30, 1897, was $2,834,468.77. At that date all the piling and revetment had been removed, 20,166,739 cubic yards of material, scow measurement, had been excavated by dredging, and 3,585,082 cubic yards had been deposited on League Island, completing the fill.

During the fiscal year ending June 30, 1898, 1,438,322 cubic yards of material, scow measurement, was dredged from Smith and Petty islands and the adjacent shoals.

The improvement was completed January 10, 1898, the resulting channel having a least depth of 26 feet with a width varying from 1,015 to 1,850 feet, extending from Morris street to the Pennsylvania Railroad Bridge, 6.2 miles.

Smith and Windmill islands were dredged to an average depth of 26 feet below mean low water, and the north side of Petty Island was dredged back so as to make the average low-water width of the Penn-

sylvania channel at that locality about 1,900 feet. Work was carried on under a contract with the American Dredging Company dated June 1, 1893.

The total amount of work accomplished to June 30, 1898, is as follows:

Material removed by dredging, scow measurement	cubic yards	21,605,061
Piling and revetment removed	linear feet	24,848
Dredged material deposited and spread on League Island, scow measurement	cubic yards	3,585,082

The reconstruction of the water fronts has progressed rapidly. Up to June 30, 1898, 22 piers had been completed to the new lines and 5 others were under construction. The city of Philadelphia is now constructing a bulkhead on the new line from Vine to South streets to permit the widening of Delaware avenue at that locality to 150 feet.

A survey of the harbor, including gaugings of flow and determination of velocities under the improved conditions, is in progress.

The foreign freight movement of the port of Philadelphia for 1897, including all points on the Delaware River, is estimated at 3,782,759 tons, and the domestic freight movement at 14,240,729 tons. The improvement has greatly facilitated navigation and increased the amount of commerce.

July 1, 1897, balance unexpended	$800,531.23
June 30, 1898, amount expended during fiscal year	798,127.17
July 1, 1898, balance unexpended	2,404.06
July 1, 1898, outstanding liabilities	300.00
July 1, 1898, balance available	2,104.06

(See Appendix H 2.)

3. *Schuylkill River, Pennsylvania.*—When the improvement was commenced in 1870, there was a channel of entrance into the mouth of the river with a depth of only 10 feet at mean low water.

The original project under which work was commenced in 1870 proposed the formation of a channel 100 feet wide, with a depth of 20 feet from the mouth of the river to Gibson Point, about 4 miles, and a depth of 18 feet thence to Chestnut Street Bridge, in Philadelphia, about 3 miles.

In 1875 and 1883 this project was amended so as to increase the low-water channel between the mouth and Girard Point, a distance of about 1 mile, to 400 feet wide and 24 feet deep, and from Girard Point to Gibson Point, about 3 miles, to 250 feet wide and 20 feet deep. In 1892 the project was again modified so as to provide for the construction of dikes to maintain a navigable depth at the mouth. The estimated cost of the entire improvement was $529,959.

The amount expended on this project to June 30, 1897, was $510,526.24. This expenditure has resulted in the formation of a channel about 125 feet wide, and from 24 to 27.5 feet deep at mean low water across the bar at the river's mouth; a channel about 250 feet wide and from 20 to 24 feet deep from inside the bar to Gibson Point, except at Yankee Point, where the width is 300 feet, and between Penrose Ferry Bridge and Yankee Point, where the 20-foot channel has narrowed to from 50 to 200 feet; thence to Chestnut Street Bridge, a channel of navigable width, and from 14 to 20 feet deep.

During the fiscal year ending June 30, 1897, 62,983 cubic yards of material, scow measurement, was dredged from the bar at the mouth of the river. The average depth of the channel across the bar along the *line of deepest water* was 27.5 feet at mean low water.

During the past fiscal year the pile dike at the mouth of the river has been raised, and repaired by spiking on the face wall two courses of 12 by 12 inch pine timber, thus raising its height to about 9.5 feet above low water. During the present season the filling of the dike will be raised to the level of the face wall by the deposit of coarse gravel and bowlders, with funds now available.

The earthen dike connecting with the pile dike has been repaired and reconstructed for a distance of 410 feet.

The city of Philadelphia is now improving the channel under authorities granted by the Secretary of War under dates of September 3, 1895, and May 14, 1896. Dredging was commenced on November 13, 1895, and is still in progress. The total amount dredged and placed ashore is about 263,370 cubic yards, as measured in the dump. This work has resulted in the formation of a channel with a mean low-water depth of 22 feet and a width of 250 feet for a distance of half a mile above Penrose Ferry Bridge, and thence a similar channel to a point about one-fourth mile above Yankee Point, except at Yankee Point, where the width is 300 feet. From a point opposite Fifty-eighth street, near Gibson Point, the channel has a width of 150 feet and a mean low-water depth of 20 feet for a distance of five-eighths of a mile.

This improvement can be completed in accordance with the adopted project with funds now available. The survey of the river provided for in the river and harbor act of June 3, 1896, with a view to further improvement, was completed in December, 1897, and a project and report thereon, submitted March 10, 1898, was printed as House Doc. No. 346, Fifty-fifth Congress, second session. It is also herewith as Appendix H 14.

The commercial interests of this river are of great and increasing value and importance. At Girard Point are located large grain elevators and wharves. At Gibson Point and Point Breeze, which are near each other and closely related as to commercial requirements, are the large storage tanks and wharves of the petroleum factories. The interests assembled at these three points cover mainly the commerce of the river, and both the grain and oil trade require deep-draft vessels for the convenient and economical transaction of their business. Channel depths are needed which will permit the passage of vessels drawing 24 feet at all stages of the tide. The total freight movement for the year 1897 is estimated at 3,587,821 tons (an increase of 373,338 tons over the year 1896) and its value at $44,405,604 (an increase of $10,107,996 over the year 1896).

July 1, 1897, balance unexpended	$14,473.76
June 30, 1898, amount expended during fiscal year	2,406.58
July 1, 1898, balance unexpended	12,067.18
July 1, 1898, amount covered by uncompleted contracts	696.00
July 1, 1898, balance available	11,371.18

(See Appendix H 3.)

4. Ice harbor at Marcushook, Pa.—This work, in its present plan, was commenced in 1866, the object being to provide a harbor in the Delaware River to protect vessels against moving ice.

In 1785 the Commonwealth of Pennsylvania built, for the convenience of commerce, piers at Marcushook, extending from the shore line into the river. It is assumed that at some subsequent time these shore piers were turned over to the United States, since in 1829 an appropriation was made of $5,000 for repairing these piers, improving the harbor, and removing obstructions. No further appropriation was made until 1866.

At this latter date the project was adopted for the construction of detached piers in the harbor, consisting of stone superstructures upon crib foundations filled with stone, together with the deepening of the harbor by dredging.

In 1888 an increased depth was proposed for the areas protected by the detached piers outside of the natural shore line of the river.

The amount expended from 1866 to June 30, 1897, was $211,584.28, which was applied to the construction of two landing piers, dredging the protected area, the placing and replacing of mooring piles, repairs to piers and mooring piles, and the necessary examinations.

During the past fiscal year the two landing piers have been repaired and a new mooring post placed.

This harbor is of great value to vessels during the prevalence of ice in the river. The cost of its maintenance is trifling in comparison with the benefit derived from it.

July 1, 1897, balance unexpended	$2,415.72
June 30, 1898, amount expended during fiscal year	700.00
July 1, 1898, balance unexpended	1,715.72

(See Appendix H 4.)

5. Construction of iron pier in Delaware Bay near Lewes, Del.—The original project of this work proposed the construction of a landing pier about 1,700 feet in length, extending from the shore south of the breakwater into Delaware Bay to a depth of 22 feet at mean low water, the pier to consist of a substructure of wrought-iron screw piles surmounted with a timber superstructure. The work was commenced in 1871 and completed, except as to superstructure, in 1880.

The amount expended to June 30, 1890, was $368,453.66 and resulted in the construction of 1,155 linear feet of pier 21 feet in width and 546 linear feet 42 feet in width, or a total length of 1,701 feet. The depth of water at the outer end of the pierhead was about twenty-one feet at mean low water.

During the fiscal year ending June 30, 1891, $7,033 was expended in replacing about 200 linear feet of the pier destroyed by the collisions of wrecked vessels in 1889, and in placing fender piles along 1,200 linear feet of the shore arm of the pier.

During the fiscal year ending June 30, 1896, the broken fender system about the head of the pier was repaired, at a total cost of $689.95.

During the fiscal year ending June 30, 1898, $6,722.39 was expended in repairing the fender system, replacing decayed wales, curbing and decking and recovering and putting in place three supporting columns.

The total expenditures to June 30, 1898, have been $385,222.39.

The right to use this pier for railway purposes, granted in the act of July 15, 1870, has never been exercised and doubtless never will be, as the pier has not sufficient strength to support the weight of modern freight engines. It is therefore impossible to obtain any assistance from the railroad company in maintaining and repairing the structure.

The pier is of great use for the purposes of the engineer, light-house, and quarantine services. It is of very great value to vessels frequenting the breakwater harbor in winter, when the harbor is packed with floating ice, rendering the anchorage dangerous. At such times vessels eagerly seek its shelter and protection.

July 1, 1897, balance unexpended	$7,660.00
June 30, 1898, amount expended during fiscal year	6,722.39
July 1, 1898, balance unexpended	937.61

(See Appendix H 5.)

6. Delaware Breakwater, Delaware.—Under the act of Congress of May 7, 1822, $22,700 was appropriated for a survey of Delaware Bay near Cape Henlopen, for the purpose of determining the site for a harbor of shelter. In 1828 an appropriation of $250,000 was made for commencing the work under a plan submitted by a Board of Commissioners appointed by Congress.

The project of the Board contemplated the construction in the concavity of the bay just inside Cape Henlopen of two massive works on the pierres perdues or riprap system, separated by an interval or gap of 1,390 feet, the greater called the breakwater, to afford safe anchorage during the gales from the north and east; the other, called the ice breaker, to protect shipping against northwesterly gales and the heavy drifting ice of the bay. This project was completed in 1869, under aggregate appropriations (including the first for survey) of $2,192,103.70. The stone used in the work amounted to 892,528 gross tons, and varied from one-fourth of a ton to 7 tons in weight, the smaller constituting the bulk of the mass, the larger used to cover the exterior slopes.

As completed in 1869 the breakwater is 2,558 feet long, and the ice breaker 1,359 feet long on top. The average width on top is 22 feet, and at base 160 feet. The top is from 12 to 14 feet above mean low water.

In 1882 a project was adopted for closing the gap between the breakwater and the ice breaker by means of a random stone foundation with a concrete superstructure. The random stone foundation was to be brought to a height of 12 feet below low water, with a width on top of 48 feet; the concrete superstructure to have a width on bottom of 24 feet, rising to a height of 12 feet above mean low water, with a width on top of 12 feet. The estimated cost of this project was $675,000.

In 1883 and 1884 the project was modified by providing a foundation of brush mattresses for the random stone substructure and omitting the construction of a pile bridge across the gap, which formed part of the project of 1882 for closing the gap.

In 1890 the concrete superstructure was further modified by establishing its base at 15 feet below low water, by making it rectangular in section, with a width of 27 feet and a height of 27 feet, and by constructing the work to above the plane of high water of large concrete blocks, above which concrete in mass was to be used. The estimated cost of the modified project, including the $356,250 appropriated from 1882 to 1888, was $856,250.

In 1891 the random stone substructure having been practically completed to an average level of 15 feet below low water, the project for the hitherto proposed concrete superstructure was modified by substitution of random stone for the remaining part of the work, so as to raise the structure to a height of 14 feet above mean low water, with a width on top of 20 feet, the width at low water to be 40 feet and the slopes below this plane to be such as may be formed by the action of the sea; between low water and the top the slopes to be about 1 on 0.7, formed by heavy stones laid in position.

Owing to recent low prices, the work has been completed with available funds and no further appropriation is required. It is probable that occasional small appropriations will be required in the future to repair damages caused by violent storms.

From the beginning of the work in 1882 to June 30, 1897, the total amount expended was $2,721,992.14, of which $529,888.44 was expended on the existing project for closing the gap.

During the past fiscal year the sum of $76,651.45 was expended in leveling and filling cavities in the substructure and completing the

superstructure. By the work done, the gap 1,390 feet long, formerly existing between the ice breaker and the main breakwater has been closed by a structure rising 14 feet above low water, 40 feet wide at low water, and 20 feet wide on top, thus forming a continuous wall from the lower end of the old breakwater to the upper end of the ice breaker.

The Maritime Exchange of Philadelphia maintains a station on the breakwater and through cables between the mainland and its station is in communication with the shipping of the harbor. Its reports state that during the year 1897, 1,619 vessels, exclusive of tugs, fishing, and small coasting craft, anchored under the protection of the breakwater.

July 1, 1897, balance unexpended	$86,361.56
June 30, 1898, amount expended during fiscal year	76,651.45
July 1, 1898, balance unexpended	9,710.11
July 1, 1898, outstanding liabilities	8,486.53
July 1, 1898, balance available	1,223.58

(See Appendix H 6.)

7. *Harbor of refuge, Delaware Bay, Delaware.*—The construction of this harbor was provided for on the continuous contract system by the river and harbor act of June 3, 1896, at a cost not to exceed $4,665,000. The act provides that in making the contracts the Secretary of War shall not obligate the Government to pay in any one fiscal year, beginning July 1, 1897, more than 25 per cent of the whole amount authorized to be expended.

No expenditures were made upon this improvement previous to June 30, 1896.

During the fiscal year ending June 30, 1897, $2,394.02 was expended and about 9,035 tons of stone was deposited for the formation of the projected breakwater. The work was commenced on May 4, 1897.

During the fiscal year ending June 30, 1898, the construction of the breakwater was continued by the deposit of about 289,709 tons of stone, making the total amount deposited to that date 298,744 tons. The substructure had then been brought to a width of 41 feet at mean low water for a distance of 2,800 feet, and thence for a farther distance of 1,900 feet it was partially completed to a height of about 10 feet below low water.

The low price provided for in the existing contract justifies a great reduction in the estimated cost of the work. It is now estimated that the total cost will not require further appropriation of more than $1,150,666, provided the annual appropriations are sufficient for rapid and economical progress.

The great value of this harbor to commerce is due to its location. It is about equidistant from New York, Philadelphia, and the capes of Chesapeake Bay (the ocean entrance to the ports of Baltimore, Norfolk, and Newport News), and is therefore an especially convenient point of call for the entire commerce of the North Atlantic Coast. It is now largely used by vessels awaiting orders to ports for discharge or loading, although the anchorage is exposed and dangerous, except for small vessels, which can find shelter in the old breakwater harbor. During the year ending December 31, 1897, 1,859 vessels (not including small craft) called at this locality.

By the construction of the breakwater the usefulness of this anchorage will be greatly increased, not only as a port of call, but also as a harbor of refuge. Vessels bound from northern to southern or from southern to northern ports will be able to go to sea in doubtful weather with the assurance of finding ample protection at the Delaware capes, *if overtaken by storm.*

July 1, 1897, balance unexpended		$396,939.98
Amount appropriated by sundry civil act approved July 1, 1898		800,000.00
		1,196,939.98
June 30, 1898, amount expended during fiscal year		279,151.73
July 1, 1898, balance unexpended		917,788.25
July 1, 1898, outstanding liabilities	$85,845.55	
July 1, 1898, amount covered by uncompleted contracts	831,942.70	
		917,788.25

Amount (estimated) required for completion of existing project	1,150,666.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	587,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H 7.)

8. *Rancocas River, New Jersey.*—In its original condition Rancocas River carried a minimum low-water depth of 4½ feet between the mouth and Centerton, a distance of about 7½ miles, and from Centerton to Mount Holly, a distance of about 5½ miles, a ruling depth of about 2½ feet.

The original project of 1881 proposed the formation, by a dike at Coats Bar and dredging elsewhere, of a channel from 150 to 200 feet wide and 6 feet deep at mean low water from the mouth to Centerton, and thence to Mount Holly a channel 5 feet deep.

Operations under this project were carried on from 1881 to 1895. To the close of the fiscal year ending June 30, 1895, operations had been directed to the formation of a low-water channel 100 feet wide and 6 feet deep from the mouth to Centerton, and 50 feet wide and 5 feet deep for a distance of about 1¾ miles above Centerton.

During the fiscal year ending June 30, 1896, no work was done.

One hundred dollars and nine cents appropriated for this work was carried to the surplus fund in 1890.

The appropriation of $2,000 for this river made in the act of June 3, 1896, is required by the act to be expended in the improvement of the Lumberton Branch.

During the fiscal year ending June 30, 1897, the Lumberton Branch was surveyed, and a project for its improvement by dredging a channel through the shoals which obstruct navigation was submitted and approved.

Up to June 30, 1897, the total expenditures amounted to $37,332.92.

During the fiscal year ending June 30, 1898, the project was completed by dredging through the shoals at Pattersons Landing, below Paxsons Landing, and partly through the shoal above Paxsons Landing, the channel having a width of 30 feet and a mean low-water depth of 6 feet.

The principal commercial interests are the manufacture of phosphorus and the transportation of sand and gravel.

The total value of the freight movement for 1897 was $1,454,350. It is believed that the cost of improving this river will be more than is justified by the resulting commercial benefits.

July 1, 1897, balance unexpended	$2,167.29
June 30, 1898, amount expended during fiscal year	1,767.59
July 1, 1898, balance unexpended	*399.70

(See Appendix H 8.)

* Balance remaining from appropriation of August 18, 1894, not available for expenditure under *present project.*

9. Alloway Creek, New Jersey.—In its original condition Alloway Creek was obstructed between its mouth and Quinton, a distance of about 10 miles, by shoal areas in the upper half of the stream which reduced the low-water depths to from 1.3 to 4 feet.

The original project of 1889 proposed the formation by dredging of a channel 6 feet deep at mean low water and 60 feet wide from Quinton to a point about 1,000 feet above the Upper Hancock Bridge; thence a channel of the same depth and 75 feet wide to a locality known as the Square, where the work is to be supplemented by a dike. At a locality known as the Canal, in addition to a channel of the last-named dimensions, the width of the stream was to be increased to about 150 feet between its low-water lines. The project was modified on December 10, 1896, so as to provide for a dike, formed by a single row of piles above the Upper Hancock Bridge. This modification does not increase the original estimated cost of the work, which is $25,000.

At the close of the fiscal year ending June 30, 1897, $12,233.92 had been expended in dredging at and near the Canal, the Square, and the Upper Hancock Bridge and in dike construction at the Square and above Upper Hancock Bridge. Channels from 40 to 75 feet wide and 6 feet deep at mean low water were formed through the worst bars.

During the fiscal year ending June 30, 1897, 404 feet of dike was constructed above Upper Hancock Bridge.

During the past fiscal year 4,269 cubic yards of material was dredged from the channel at Upper Hancock Bridge. The commerce of this creek consists of miscellaneous articles, such as coal, sand, lumber, and produce, and is principally of a local character. The value of the total freight movement for 1897 was $892,800. The improvement has been of much benefit to navigation at a comparatively small cost. About three-fifths of the projected work has been accomplished.

July 1, 1897, balance unexpended	$2,766.08
June 30, 1898, amount expended during fiscal year	2,413.53
July 1, 1898, balance unexpended	352.55
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H 9.)

10. Cooper Creek, New Jersey.—This creek enters the Delaware River in the city of Camden, just above Cooper Point. It is navigable for a distance of 9 miles from its mouth for vessels drawing 5 feet, and for the first 5 miles for vessels of 11½ feet draft. The mean range of tide is about 6 feet. For a distance of 1½ miles from the mouth the width of the stream averages about 80 feet at low water and about 120 feet between the banks, and the channel has a depth of from 12 to 15 feet, except at one place, where the depth is 9½ feet.

The project for this improvement is printed in the Annual Report of the Chief of Engineers for 1895, page 1102.

It is proposed to dredge a channel 70 feet wide at bottom and 18 feet deep at mean high water from the mouth of the creek to Browning's Chemical Works, and a channel of the same dimensions through the bar just outside the mouth, in all a distance of about 9,000 feet, requiring the excavation of about 135,000 cubic yards of material, place measurement, and, including contingencies, the estimated cost is $35,000.

The river and harbor act of June 3, 1896, appropriated $37,000 for completing this improvement, of which $2,500, or so much thereof as

might be necessary, was to be expended in rebuilding the dike on the Government reservation in the Delaware River at Woodbury Creek.

At the close of the fiscal year ending June 30, 1896, no work had been done.

During the fiscal year ending June 30, 1897, the sum of $2,500 was expended in rebuilding the dike on the Government reservation at Woodbury Creek, and the sum of $389.94 was expended in the preliminary expenses of the work and in dredging material from the channel of the creek.

During the past fiscal year 47,735 cubic yards of material, scow measurement, was dredged from the channel between State Street Bridge and the mouth of the creek, making the total amount dredged to date 47,790 cubic yards, scow measurement.

There are 9 large manufacturing plants on this creek, consisting of 1 woolen mill, 1 nickel works, 4 chemical works, 1 glass works, and 2 iron works. It is claimed that with an improved channel the most economical way of receiving materials and shipping products will be by schooners instead of by rail, as at present.

The value of the total freight movement for 1891 was nearly $3,000,000, and for 1897 $2,468,145.

July 1, 1897, balance unexpended	$34,110.06
June 30, 1898, amount expended during fiscal year	2,991.58
July 1, 1898, balance unexpended	31,118.48
July 1, 1898, outstanding liabilities	4,204.12
July 1, 1898, balance available	26,914.36

(See Appendix H 10.)

11. Goshen Creek, New Jersey.—In its original condition Goshen Creek carried a low-water depth of from 2 to 4 feet, with a least low-water width of 20 feet and a high-water width of 36 feet from Goshen to a point about 4,000 feet below; and thence to the mouth, a distance of about 2,500 feet, a low-water depth of from 3 to 5 feet, with a least width of 30 feet.

The project for its improvement, adopted in 1891, proposed the deepening and widening by dredging of the 4,000 feet of the creek below Goshen Landing to a low-water depth of 3 feet and a width of 30 feet; the formation of a dredged channel, 3 feet deep and about 50 feet wide, through the bar at the mouth to the limit of the sand beyond the low-water line, and the protection of the channel by a sheet-pile jetty.

The improvement was commenced during the fiscal year ending June 30, 1893, and to the close of that year the sum of $2,770.16 was expended in widening and deepening the channel to the proposed dimensions over a distance of about 3,975 feet below Goshen Landing. By this work about one-fourth of the projected improvement had been completed and the navigable conditions had been proportionately improved.

The sum of $3,000 appropriated in the river and harbor act of August 18, 1894, was not sufficient to carry on the work in accordance with the project. It was therefore withheld until a further appropriation was made by Congress.

The total amount expended to the close of the fiscal year ending June 30, 1897, was $3,162.60.

During the fiscal year ending June 30, 1897, the pile dike was constructed to its projected length of 600 feet, and 8,002 cubic yards of material was removed from the channel in the vicinity of the dike.

The original cost of the project made in 1891 was estimated at $12,000, this estimate being based on a single appropriation of $12,000, by which the improvement could be made in a single season. On account of the

small appropriations, the execution of the work has been carried through an interval of several years, and it has not been executed with sufficient rapidity to prevent injurious changes which will considerably increase the cost of the improvement.

During the past fiscal year an estimate for the completion of the project, based on a careful survey of present conditions, was made. In order to maintain the dredged channel it will be necessary to extend the dike somewhat farther inshore and dredge through the bar at the mouth of the creek. The cost of this work, in addition to funds now available, is estimated at $8,000, which will increase the cost of the project from $12,000, as originally estimated, to $17,000.

The commerce of this creek consists of miscellaneous articles, such as sand, oysters, lime, coal, and lumber, and is principally of a local character. The value of the total freight movement for 1897 was $398,100. The improvement has been of much benefit, at moderate cost.

July 1, 1897, balance unexpended	$5,837.40
June 30, 1898, amount expended during fiscal year	4,282.76
July 1, 1898, balance unexpended	1,554.64
Amount (estimated) required for completion of existing project	8,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix H 11.)

12. Removing sunken vessels or craft obstructing or endangering navigation.—During the past fiscal year no wrecks were removed under the provisions of the act of June 14, 1880.

The removal of the wreck of the schooner *Lottie K. Friend*, under contract dated February 18, 1897, with Thomas Poynter and Elijah D. Register, of Lewes, Del., in progress during the fiscal year ending June 30, 1897, has not yet been completed, and the annulment of the contract was recommended June 16, 1898, and approved June 18, 1898.

Allotments were made for the removal of the wrecks of the following vessels:

Ship *Francis*, from Little Egg Harbor Inlet, New Jersey. Before contract for its removal could be entered into the wreck had sunk in the sand and, by the shifting of the channel, had ceased to be an obstruction to navigation. Pleasure boat *David W. Sellers*, from Schuylkill River, Pennsylvania. Before contract for its removal could be entered into the wreck was removed by private persons and placed where it was no longer an obstruction to navigation. Schooner *Anna Maria*, from Maurice River, New Jersey. Proposals for the removal of the wreck will be opened July 18, 1898.

The amount expended in connection with removal of wrecks during the past fiscal year was $153.53.

(See Appendix H 12.)

SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The surveys of the following localities, required by the river and harbor act of June 3, 1896, were made by the local engineer, Lieut. Col. C. W. Raymond, Corps of Engineers, and reports thereon submitted:

1. Survey of Delaware River with a view to obtaining a channel 600 feet wide and 30 feet deep from a point at or near the city of Philadelphia to the deep water of Delaware Bay.—Colonel Raymond submitted report *of survey January 5, 1898.*

The systematic improvement of this river with a view to obtaining a channel 600 feet wide and 26 feet deep at mean low water from Philadelphia to the bay is now in progress, and that portion of the river along the front of the city of Philadelphia has been improved to the extent of securing a channel having a least depth of 26 feet and a least width of 1,000 feet, while from the foot of Petty Island to a point opposite Christian street, Philadelphia, there is practically a depth of 30 feet at mean low water over a width of 600 feet.

The project now presented contemplates improving the river from a point opposite Christian street, Philadelphia, to the bay, along the axis of the main ship channel, to obtain a channel 600 feet wide and 30 feet deep at mean low water, by dredging and by removal of rock near Petty Island and at Schooner Ledge, estimated to cost, including contingencies, $5,935,000, exclusive of work now under contract and work authorized by the Secretary of War to be done by the city of Philadelphia, as indicated.

Colonel Raymond states that under the most favorable conditions the execution of the project will require about six years; that to conduct the work successfully and economically it should be done under a continuous contract, and that the above estimate of cost is based upon the assumption that the improvement is to be executed by this method.

The question of maintenance of the proposed channel is fully discussed by Colonel Raymond in his report, and his views on this point are summarized as follows:

> I am of the opinion that the practicability of maintaining a channel 30 feet deep at mean low water at reasonable cost from the mouth of the river to Pea Patch Island can only be determined by trial, and that such a channel could undoubtedly be maintained at reasonable cost above Pea Patch Island, except at Cherry Island Flats, where there is reasonable ground to hope for success.

In his letter transmitting this report to this office Colonel Raymond states that in his opinion the proposed improvement is worthy of execution and justified by the needs of the commerce involved.

The report was transmitted to Congress and printed in House Doc. No. 219, Fifty-fifth Congress, second session. (See also Appendix H 13.)

2. Survey of Schuylkill River, Pennsylvania.—Colonel Raymond submitted report of survey March 5, 1898.

This report contains a project for improvement of the river from its mouth to the head of navigation at Walnut Street Bridge by dredging and rock removal as follows:

1. *Lower section*, from outside the bar at the mouth to Penrose Ferry Bridge, a distance of about 1½ miles, to secure, by dredging, a channel having a bottom width of 400 feet and a depth of 26 feet at mean low water.

2. *Middle section*, from Penrose Ferry Bridge to Gibson Point, a distance of about 3 miles, to secure, by dredging, a channel having a bottom width of 390 to 400 feet, with a depth of 26 feet at mean low water.

3. *Upper section*, from Gibson Point to Walnut Street Bridge, to secure, by dredging and rock removal, a channel having a bottom width of 320 to 400 feet and a depth of 22 feet at mean low water.

The estimated cost of the work proposed is as follows:

Lower section	$433,000
Middle section, excluding work already provided for by the city of Philadelphia	1,140,000
	1,573,000
Upper section, excluding work already provided for by the city of Philadelphia	1,580,000
Total	3,153,000

Colonel Raymond states that occasional dredging will be required to maintain the channel; that the improvement of the lower section could be undertaken immediately and completed in about two years should sufficient funds be provided, but that the improvement of the middle and upper sections could not be commenced and executed to advantage until work under the contract of the city of Philadelphia has been completed.

In his letter transmitting this report Colonel Raymond says:

> In my opinion the lower and middle sections of the river, as defined in the project, are worthy of improvement, and their improvement is justified by the interests of commerce involved. The necessities of commerce are not, in my opinion, sufficient to justify the large expenditure required for improving the upper section at the present time.

The report was transmitted to Congress and printed in House Doc. No. 346, Fifty-fifth Congress, second session. (See also Appendix H 14.)

3. *Survey of Mantua Creek, New Jersey.*—Colonel Raymond submitted report of survey October 22, 1897. The improvement proposed is to secure a channel 100 feet wide at bottom and 12 feet deep from the 12-foot contour in Delaware River to the phosphate works; thence 80 feet wide at bottom and 8 feet deep to Paulsboro; thence 60 feet wide at bottom and 7 feet deep to Parkers Landing, and to construct, 9,000 feet above Berkeley, a cut-off 350 feet long, 50 feet wide, and 3 feet deep, and to remove overhanging trees above Parkers Landing.

Two plans for securing such a channel have been considered. The first contemplated the formation of a dredged channel by making six cut-offs through the lowlands wherever practicable, avoiding shoals and sharp bends, and the second provides for widening and deepening the present waterway by dredging. The former plan is the one desired by the people of Paulsboro, as it shortens the distance between that place and the mouth of the creek nearly 2 miles.

The first plan will require an estimated expenditure of $112,630, provided all rights of way can be secured to the United States and riparian rights quieted for a sum not to exceed $11,000, and the second plan $109,000. In the event of jetties being required at the mouth of the creek these estimates will be increased to $145,030 and $141,400, respectively.

Colonel Raymond is of the opinion that the creek is worthy of improvement, and that its improvement is justified by the interests of commerce involved.

The report was transmitted to Congress and printed in House Doc. No. 123, Fifty-fifth Congress, second session. (See also Appendix H 15.)

4. *Survey of Absecon Inlet, New Jersey, with a view of maintaining 10 feet of water over the bar.*—Colonel Raymond submitted report of survey January 14, 1898. A full description of the physical characteristics of this locality, with plan and estimate for securing 20 feet over the bar, will be found in a report by a Board of Engineers, dated May 31, 1887, upon a survey made in 1886 with a view to the formation of a harbor of refuge (printed in Annual Report, Chief of Engineers, 1887, p. 815).

The project now presented provides for maintaining 10 feet at mean low water over the bar by construction of a stone jetty on the east side of the inlet, extending from Brigantine Beach to deep water, estimated to cost, including contingencies, $500,000.

Colonel Raymond states that, since this work will require special plant and should be executed rapidly to insure success, it can be best and most economically done under a continuous contract, the work being, in his opinion, worthy of execution and justified by the needs of the commerce involved.

The report was transmitted to Congress and printed in House Doc. No. 252, Fifty-fifth Congress, second session. (See also Appendix H 16.)

IMPROVEMENT OF RIVERS AND HARBORS IN DELAWARE, IN MARYLAND EAST OF CHESAPEAKE BAY, AND OF INLAND WATERWAY FROM CHINCOTEAGUE BAY TO DELAWARE BAY, VIRGINIA, MARYLAND, AND DELAWARE.

This district was in the charge of Wm. F. Smith, United States agent, major of engineers, United States Army, retired. Division Engineer, Brig. Gen. Peter C. Hains, U. S. Volunteers, colonel, Corps of Engineers.

1. Wilmington Harbor, Delaware.—Previous to 1836, when the first appropriation for the improvement of the Christian River was made, the depth of water at the entrance was about 8½ feet. The minimum depth in the channel of the portion of the river below Third Street Bridge was 8 feet. This depth was increased by dredging in that year to 10 feet.

Under a project commenced in 1871 and completed in 1881, a 12-foot channel from 100 to 200 feet wide was made from the mouth to above the city of Wilmington. In 1881 a project was adopted for a 15-foot low-water channel from the mouth of the river to the pulp works, with a width of 150 feet from the mouth to the Rolling Mill wharf, 100 feet to the Delaware and Western Railroad Bridge and 75 feet to the pulp works. This project included, further, a channel 12 feet deep and 50 feet wide from the latter works to the Delaware Railroad Bridge and construction of a jetty on the north side of the mouth of the river. Operations under the project were begun in the following year. The original estimate was $175,551, which was increased in 1883 to $191,384 by changing the width of the proposed channel to 150 feet throughout. In 1884 the project was amended by raising the height of the jetty 4 feet. The channel was made 150 feet wide and 15 feet deep at mean low water by dredging and rock removal, from the 15-foot depth outside the bar at the mouth to a point 2,515 feet above Market Street Bridge, 80 feet wide thence for a distance of 820 feet, and thence 40 feet wide to the pulp works. This was the work done to 1893. Under a contract commenced in March, 1896, and completed the following September, the channel was dredged, where it had shoaled, to a width of 150 feet and a depth of 13 feet at mean low water from the 13-foot contour in the Delaware River to a point about 1,000 feet above the mouth of the Brandywine; and with $15,000 of the appropriation made in 1896 dredging was continued thence, and the channel given a width of 150 feet for a length of 385 feet, and a width of 100 feet for a further length of 400 feet, the depth made in both cases being 15 feet at mean low water to the close of the fiscal year, June 30, 1897, at which time operations were still in progress.

The river and harbor act of June 3, 1896, appropriated $5,000 for improving the channel between Churchman's Bridge and Smalley's Bridge, in the upper part of the river, and with this a continuous channel was dredged to a width of 25 feet and a least depth of 3 feet at mean low water for a distance of 3.35 miles from Churchman's Bridge toward the bridge at Christiana village, and a similar channel for a distance of 4,033 feet above that bridge toward Smalley's Bridge. This work was completed December 31, 1896.

The amount expended for the improvement of the Christiana River and Wilmington Harbor to June 30, 1897, is $378,201.84, of which $262,345.84 was expended on the project of 1881 and its modifications.

The river and harbor act of June 3, 1896, authorized the making of contracts to complete the "modified project," which was understood to be *the project for a 21-foot channel, at a cost not to exceed* $225,846.

Report upon this project will be found in the Annual Report of the Chief of Engineers for 1896, pages 973–994.

As it was doubtful whether the project could be carried out under the conditions of the law authorizing a contract, a Board of Engineer Officers was convened by the Chief of Engineers to consider and report upon the plan of improvement.

The report of the Board is given in Appendix H 1 of the report for 1897, page 1255 et seq.

The Board expresses the opinion that the existing project can not be successfully carried out and recommends a modified project, including the construction of a jetty on the south side of the entrance to the river, the rectification of the channel of the Christiana River at the mouth of the Brandywine, and necessary dredging to give a channel of 21 feet at mean low water from the mouth to the upper line of the pulp works. The estimated cost is $377,542. It is stated that the proposed channel is of greater dimensions than the river can naturally maintain and that annual dredging will be necessary. The United States agent in local charge of this work estimates that certain rock work not included in above estimate will increase the cost of work $99,000.

Under a project for the expenditure of the available funds, in conformity with a recommendation of the Board, a contract for dredging was made and work thereunder begun on June 24, 1897. The operations under the contract to the close of the fiscal year 1897 are stated above. These operations were continued in an upriver direction to September 1, 1897.

Under a supplementary contract, dated August 26, 1897, a bar which had formed at the mouth of the river since the work of 1896 was removed, giving the channel there a width of 150 feet, with a minimum depth of 15 feet at mean low water. A survey of the work after its completion developed the fact that for nearly the whole length of the channel just dredged the soft mud had been washed into the cut, contracting its bottom width to an average of 120 feet, the channel depth remaining 15 feet. Immediately above the wharves of the Philadelphia and Wilmington Steamboat Company the channel had contracted so that at one point the 15-foot channel was but 25 feet wide. On either side of this point the channel widened out again.

No contract for work in excess of appropriations under the authorization given in the act of June 3, 1896, has been entered into for this improvement in view of the necessity for an increase in the limiting cost.

The important commercial interests of this city warrant liberal expenditures in making and maintaining a proper channel.

July 1, 1897, balance unexpended	$23,992.94
June 30, 1898, amount expended during fiscal year	23,992.20
July 1, 1898, balance unexpended	.74
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	195,780.00

(See Appendix I 1.)

2. Ice harbor at Newcastle, Del.—This harbor is one of the oldest on the Delaware River, constructed for the protection of vessels against floating ice, its origin dating back to colonial times. For many years it was the northern terminus of the New Castle and Frenchtown Railroad, one of the oldest in the country, from which transfers were made upon boats sailing to and from Philadelphia and farther north. Since the beginning of the present century its improvement and enlargement

have been carried on by the United States Government at different periods, and up to the close of the fiscal year ending June 30, 1897, $224,703.84 had been expended, of which $22,559.95 was on the project of 1884.

Under the project adopted in 1884 Pier H was rebuilt, Pier M repaired and riprap placed around it and Pier N, and the shoaler portion of the harbor was dredged to a depth of 18 feet below mean low water from the 18-foot contour to within 10 feet of the wharf line. The harbor space for deep-draft vessels was thus materially increased.

During the past fiscal year, under authority from the Chief of Engineers, Piers L, K, and C have been repaired at a cost of $244.25, derived from allotment from appropriation for examinations, surveys, and contingencies of rivers and harbors. The work consisted mainly in replacing stones which were broken or out of position.

Attention was called in the report of 1892 to the practicability of materially enlarging the area of the harbor by the construction of an additional pier on the 30-foot contour at the point of intersection of two lines prolonged over Piers K and M, and L and N, respectively. The two outermost piers, M and N, are at present too far apart to shelter the harbor effectually against running ice when strong easterly winds prevail. Also, as many of the ice piers, especially the older ones, are liable at any time to be damaged by ice or by collision with vessels and may need immediate repair, a small sum should be available to keep them in proper condition; and to make the area of the harbor available to the utmost of its capacity a harbor master should have control of the harbor to order the placing of vessels during the ice season when the demand for refuge is great.

No statistics were obtainable.

Newcastle is in the collection district of Delaware. Wilmington is the nearest port of entry, and the amount of revenue collected there during the fiscal year ending June 30, 1898, was $23,446.

(See Appendix I 2.)

3. *Appoquinimink River, Delaware.*—At the time of the adoption of the present project there was a mean low-water depth of 2 feet at the entrance into Delaware Bay, and the shoalest depth inside the river was 4½ feet. The most serious obstructions to the navigation of the river were the many bends in the lower and middle sections.

The approved project is based upon a survey made in 1889, and is for a channel 8 feet deep at mean low water, having a width of 80 feet from the bridge at Odessa to near Townsend's wharf, a distance of 3¼ miles, and a width of 100 feet from this wharf to the mouth of the river, a distance of 5 miles. The estimated cost of the improvement is $39,963.

In 1891 the channel was dredged to the full width of 80 feet and depth of 8 feet at mean low water for a distance of 1,975 feet in a down-river direction, beginning at the lower end of Watkins's wharf, at Odessa, and early in 1893 a farther distance of 4,487 feet was dredged. Of the latter, 595 feet was dredged to the approved width, but on account of the settlement and sliding in of the very soft marsh banks, upon which the excavated mud and sand were deposited, the full approved width of 80 feet could not be made along the remainder, 3,892 feet, and it was therefore made only 50 feet until the banks should become firmer. The entire length dredged is 6,462 feet, of which 2,570 feet is 80 feet wide and 3,892 feet is 50 feet wide. The channel was thereby materially improved as far as the work had progressed, giving great relief to the shipping, and the harbor room at Odessa increased.

The amount expended on this improvement to the close of the fiscal year 1897 was $10,888.98. No dredging has been done during the past year, but work under contract, dated July 2, 1897, is expected to be begun in a few days.

The work proposed to be done is the dredging of the channel to a depth of 8 feet at mean low water and a width of 50 feet in straight reaches and widening in the bends through various shoals between a point 6,400 feet below Odessa, where work was last suspended, and the mouth of the river; to widen the cut-off below New Bridge, to dredge off several projecting points, and to redredge shoaling in the upper river as far as available funds will permit. It was intended to include in this work the making of the proposed cut-off at New Bridge and one below, but it was impracticable to procure the title to the land required for the purpose. The difficulties in the way may possibly be overcome before further improvements on the river are completed.

The commerce in the river is reported for the past year to have been 21,425 tonnage, valued at $1,283,850, as against 19,132 tonnage, valued at $980,975, in 1891, shortly after the improvement of the river was begun. The extent of the commerce justifies the outlay for the proposed improvement.

July 1, 1897, balance unexpended	$9,111.02
June 30, 1898, amount expended during fiscal year	101.06
July 1, 1898, balance unexpended	9,009.96
July 1, 1898, amount covered by uncompleted contracts	9,009.96
Amount (estimated) required for completion of existing project	19,963.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	7,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix I 3.)

4. Smyrna River, Delaware.—This river, formerly called Duck Creek, had, before improvements were begun in 1879, a minimum depth of 2½ feet within the river and about 4 feet over the bar at the mouth. Navigation was possible only at high tide, and was carried on by one steamer and seven small schooners.

In 1878 a project was made for the improvement of the whole river, including a plan for deepening the channel across the bar at the mouth.

By special direction of Congress the improvement of the bar was commenced first, and during the following four years three appropriations, aggregating $10,000, were expended in dredging a channel across this obstruction 100 feet wide and 8 feet deep at mean low water. The dredged channel soon filled up again.

A new project was submitted in 1887 for a 7-foot low-water channel 60 feet wide inside the river and 100 feet at the bar, the channel at the latter point to be protected by a stone jetty. The estimated cost of this project is $91,698.40. The first appropriation under the project, that made in 1888, was for dredging, and the appropriations made since have provided for continuing the improvement and have likewise been applied solely to dredging. The estimated cost of the dredging was $37,365.20, and that for the jetty was $53,733.20.

In 1893 the channel was dredged to the approved dimensions for a length of 4,730 feet, in seven different localities between Smyrna Landing and Gravel Reach, about 5 miles below. Dredging had been done there previously, but not to the full dimensions. Also a cut 50 feet wide and 7 feet deep through a narrow bar about a half mile inside the mouth of the river. In 1896, to June 30, the turning basin at Smyrna Landing was redredged to the full dimensions, and the channel below

dredged to the full width and depth at Price's wharf, Limekiln wharf, Beaverhouse Reach, the reach above and below Rothwells Landing and below the "Canal;" and in September and October, 1896, the channel was dredged at six different parts of the river between Smyrna Landing and Cave Landing Reach, a distance of 20,400 feet, the depth made being 7 feet, the width varying between 40 and 60 feet.

The total amount expended on this improvement to June 30, 1897, was $32,963.10, of which $22,963.10 was on this project.

Under contract dated June 15, 1897, for the expenditure of the appropriation of $5,000 made by the river and harbor act of June 3, 1896, dredging was begun on December 8, 1897, at Cave Landing, and continued thence downstream to Cherrytree Reach. In this section shoals at Cave Landing, at Long Reach, the entire length of Gravel Reach, and lower end of canal, and thence to Eagle Nest Landing, the upper end of Northwest Branch, and at and through Cherrytree Reach, aggregating 10,996 feet in length, were dredged, resulting in a channel of the approved dimensions from Cave Landing downstream for a length of 13,705 feet, with the exception of about 300 feet just below Eagle Nest Landing, where the depth and width are at some places slightly less. The channel below Cherrytree Reach to the mouth is in a fair condition, but needs some dredging at several points to give the approved dimensions.

In the section above Cave Landing the most troublesome shoals were removed. These were at Deep Hole, just below Rothwells Landing, the upper end of Mill Creek Canal, Beaver House, and about 900 feet of a shoal at Walraven Reach, aggregating 4,275 feet, were dredged to the approved dimensions, except the one at Deep Hole, where the width made was only 50 feet, giving an unobstructed navigation from Cave Landing upstream for a length of 15,470 feet to Walraven Reach.

The commerce in the river is reported for the past year to have been 315,680 tons and of a valuation of $2,939,930. Before the improvements were begun, the tonnage and valuation were reported to be 204,706 tons and $1,944,000. The extent of the commerce justifies the outlay for the improvement.

July 1, 1897, balance unexpended		$5,036.90
June 30, 1898, amount expended during fiscal year		3,998.66
July 1, 1898, balance unexpended		1,038.24
July 1, 1898, outstanding liabilities	$850.00	
July 1, 1898, amount covered by uncompleted contracts	130.00	
		980.00
July 1, 1898, balance available		58.24
Amount (estimated) required for completion of existing project		9,365.00
Amount that can be profitably expended in fiscal year ending June 30, 1900		9,365.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix I 4.)

5. *Murderkill River, Delaware.*—This river is a tidal stream and a tributary of Delaware Bay, and flows through Kent County, Del. Its navigable portion is about 9 miles long. The condition of the river was fair for the greater part of its length, the average width and depth being 90 and 6 feet, respectively. Outside the junction with Delaware Bay, however, there is a serious obstruction—the flats—which are nearly bare at low tide and extend for nearly a mile from the shore. The average rise and fall of the tide at the mouth is 4.6 feet.

In 1881 an examination of this river was made and a project submitted for its improvement. No appropriation was made by Congress, however, as the river was at that time in the hands of an improvement

and navigation company chartered by the State. This company had expended about $10,000 in rectifying the many bends of the river by cutting straight canals and in dredging a narrow cut across the flats at the mouth. The latter slowly filled up again.

The project for improvement adopted in 1892 is for a 7-foot low-water channel 80 feet wide from the town of Frederica, at the head of navigation, to the mouth of the river, and 150 feet wide from the mouth across the flats outside to the 7-foot depth in Delaware Bay, the cut at the mouth to be protected by forming an embankment of the dredged material on each side, the estimated cost being $47,550.

In 1893 a channel was dug to a depth of 5 feet below mean low water across the flats from a short distance inside the river to the 5-foot depth in Delaware Bay, and in 1895 a cut-off 975 feet long was made at Lower Landing, about 4 miles from the mouth, and shoals were dredged at a sharp turn in the river below Frederica, at the head of Long Canal, at Coles Shoal, and just inside the mouth of the river. The width of the cut in every case was 40 feet and the depth 7 feet at mean low water. In the winter of 1896–97 a channel was dredged 60 feet wide and 6 feet deep at mean low water from the 6-foot curve in Delaware Bay to the steamboat wharf inside the river, a distance of 4,700 feet, and shoals just above the steamboat wharf, at Broad Reach and at Webbs Landing, aggregating 2,482 feet in length, were dredged to a width of 40 feet and a depth of 6 feet, resulting in an unobstructed low-water navigation of 6 feet from that depth in Delaware Bay to Lindells Shoal, a distance of 16,000 feet.

The amount expended on the project to the end of the fiscal year 1897 was $18,328.68. In addition to this $1,500 was expended in removing a shoal at the mouth of the St. Jones River, as required by river and harbor act of August 18, 1894. No dredging was done during the past fiscal year. Expenditures during the year were for plotting work completed in June, 1897, etc.

The commerce of this river, which is quite varied, is reported for the past year to be represented by a tonnage of 42,542 and a valuation of $581,210. There appears to have been quite an increase since the improvements were begun, and a steamboat line has in consequence of this improvement been established between Frederica and Philadelphia.

July 1, 1897, balance unexpended	$171.32
June 30, 1898, amount expended during fiscal year	153.87
July 1, 1898, balance unexpended	17.45
Amount (estimated) required for completion of existing project	32,764.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	7,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix I 5.)

6. *Mispillion River, Delaware.*—This river is a tidal stream, and enters Delaware Bay about 17 miles northwest of Cape Henlopen. It is navigable for about 12 miles. The mouth of the river is greatly obstructed by a flat foreshore without a channel. Vessels can enter and depart only at high water, which rises, on an average, 4 feet.

The river from Milford to the mouth was improved by the General Government between the years 1879 and 1889, and $17,000 was expended in making a channel 40 feet wide and 6 feet deep at mean low water.

The project for the improvement at the mouth of the river, proposed in a report on a survey made in 1891, provides for a cut across the flats in a southeasterly direction, having a width of 150 feet and a depth of *6 feet at mean low water*, beginning opposite the light-house and end-

ing in deep water in the bay, the cut to be protected on the upper or north side by a bank made of the excavated material. The estimated cost is $24,000.

In 1893 operations were begun under the project, and at the close of work in that season a pile dike 500 feet long had been built on the north side of the mouth, along the line of the channel, and a channel had been dredged for a length of 570 feet, 80 feet wide and 5 feet deep at mean low water, extending from the 5-foot depth in the Mispillion River to a point opposite and 50 feet west from the outer end of the dike, and in 1895 and 1896 a channel was dredged 75 feet wide and 6 feet deep at mean low water from inside the river just above Sandy Point to opposite the mouth of Cedar Creek, and a crib dike 350 feet in length, flanking the new channel on the west side, was built. The dikes were found necessary during the progress of the dredging owing to the character of the material dredged, which was mainly treacherous sand. The total amount expended on this improvement to June 30, 1897, was $34,629.67, of which $17,629.67 was expended on the present project.

During the fiscal year a brush and stone extension to the pile dike constructed the preceding year has been built. It was done under contract, dated June 25, 1897. Work was begun July 14 and completed August 21, 1897. The extension is 200 feet in length, and is built up to the level of mean high water, with a top width of 5 feet.

Under a contract for dredging, dated July 2, 1897, a cut was made near the end of the crib dike, 50 feet wide and 6 feet deep at mean low water, and 450 feet long. The stormy weather continuing, dredging was suspended and an attempt made to raise with the dredge the loose portion of the crib dike, the end of which had been undermined during the gales of the latter part of October and early in November. One crib was removed. Dredging operations were resumed on November 18, in extending the channel across the Bulkhead Shoal, about 400 feet beyond the mouth. A cut across the Bulkhead Shoal was made, 4 feet deep and 40 feet wide, for a length of 675 feet, resulting in a continuous channel 4 feet deep at mean low water from inside the river to and across the Bulkhead Shoal outside. The contract for this work was closed November 30, 1897.

The commerce of this river consists principally of lumber, railroad ties, grain, canned goods, lime, and fertilizers, and is reported for the past year to have been 83,129 tons, and of a valuation of $1,676,704. In 1897, when the project was adopted, shipments and valuation were reported to be 44,315 tons and $916,250, respectively. It is not likely that the commerce will be benefited to any extent by the improvements until such work is carried out as will give and maintain a depth of 6 feet.

It is estimated that $500 will be required for maintenance of the improvement during the fiscal year ending June 30, 1900.

July 1, 1897, balance unexpended	$4,370.33
June 30, 1898, amount expended during fiscal year	4,257.75
July 1, 1898, balance unexpended	112.58
July 1, 1898, outstanding liabilities	112.58
Amount (estimated) required for completion of existing project	2,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, for continuing improvement	2,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement	500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See *Appendix I 6.*)

7. *Broadkiln River, Delaware.*—In its original condition the depth of water in the river was from 3 to 4 feet at the numerous shoals which impeded navigation. The depth at the entrance was and still is from 1½ to 2 feet at low water.

The original project for improvement, made in 1871, is for a 6-foot low-water navigation, with a minimum width of 40 feet from the mouth of the river to Milton, the head of navigation, and for a new entrance, protected by a jetty, at an estimated cost of $80,447. This project was modified in 1881 relative to the entrance, and the estimate reduced to $51,450. The channel within the river has been completed in accordance with the project, at an expense of $35,000, which was the total amount expended at the close of the fiscal year ending June 30, 1897. Upon completion of the work vessels after entering were no longer detained by the shoals at low tide and could proceed directly to their destination.

No work was done during the fiscal year.

Amount (estimated) required for completion of existing project	$21,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix I 7.)

8. *Inland waterway from Chincoteague Bay, Virginia, to Delaware Bay at or near Lewes, Del.*—The original project, based on a survey made in 1884, provided for a channel 70 feet wide at the bottom and 6 feet deep below mean low water in the Delaware Breakwater Harbor connecting the inland bays between Chincoteague Bay and Delaware Bay, the northern outlet to be at or near Lewes, Del. The length of the proposed waterway is about 75 miles, and the cost was estimated at $350,000. This project was modified in 1892, the width of the proposed channel having been reduced to 20 feet at the bottom.

A cut has been made 4 miles long, 20 feet wide at bottom, and 4 feet deep below the mean level of Assawaman Bay across the neck of land lying between Little Assawaman Bay and Whites Creek, a tributary of Indian River Bay, and three temporary wooden bridges built over it; a cut 20 feet wide and 6 feet deep below datum (mean low water at Delaware Breakwater) has been made from that depth in Rehoboth Bay to a point 1,250 feet south of the Delaware, Maryland and Virginia Railroad crossing at Rehoboth, a distance of 9,000 feet, and another cut, in continuation of this, extending to the railroad reservation, a distance of 1,125 feet, has been made to a depth of 2 feet below mean low-water level; and north of the railroad crossing a cut was made to a point 1,000 feet north of the boundary of the railroad track. Of this latter distance the lower 800 feet was excavated to a depth of 9½ feet and the remaining 200 feet to an average depth of 15 feet above datum, the depth of cutting in the first averaging approximately 17½ feet and in the latter about 8 feet. All slopes of excavations were made 2 to 1 along the lines determined by the final width at the base of the proposed cut and the configuration of the ground. The cut between Assawaman Bay and Whites Creek was made and the three bridges built in 1891. The remainder of the work described was done between 1893 and February, 1896.

The amount expended on the project to June 30, 1897, was $166,697.70, and the condition of the work when last examined, in 1896, was as follows: The cut made between Whites Creek and the head of Little Assawaman Bay to a depth of 4 feet had shoaled considerably, at the northern end to eight-tenths of a foot and in the middle portion to 2 feet. The first-named shoal is in the deepest portion of the cut, where

the sandy side slopes, bare of all vegetation, fall in considerably during heavy rains. The depths in the cut through low or marshy ground had maintained themselves very well. The cut made to a depth of 6 feet from Rehoboth Bay along Millers Creek toward the high ground back of Rehoboth, during the working season of 1894, was in fair condition except the formation of a slight shoal in line with the bay shore, which was evidently caused by wave action.

The river and harbor act of June 3, 1896, appropriated $25,000 for continuing this improvement, but until certain litigation regarding right of way is settled it is not likely that any dredging work can be done.

During the fiscal year efforts have been directed toward obtaining title to the railroad crossing at Rehoboth, the Department having decided to condemn the land.

July 1, 1897, balance unexpended	$27,052.30
June 30, 1898, amount expended during fiscal year	551.66
July 1, 1898, balance unexpended	26,500.64
Amount (estimated) required for completion of existing project	156,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix I 8.)

9. *Susquehanna River above and below Havre de Grace, Md.*—Before improvements were begun in this section of the river the least depth of water over the shoals between Havre de Grace and Spesutia Island was 5 feet at low water. The channel above Havre de Grace between Watson Island and the shoal running out from the west shore was narrow, and believed to be one of the causes of ice gorges at and near Port Deposit.

Improvements have been in progress since 1852. The present general project is for a 15-foot low-water channel below Havre de Grace and for the removal of the shoal opposite Watson Island to a depth of 8 feet below mean low water. Estimated cost, $168,000.

The channel below Havre de Grace was dredged the last time in 1885. It has shoaled again. The channel at Watson Island has been widened about 400 feet, but the shoal which was removed has nearly entirely re-formed since the discontinuance of work in 1889.

Up to the close of the fiscal year ending June 30, 1897, $161,067.37 had been expended on this section of the river, including $49,729.15 for work for the Fish Commission.

There were no operations during the fiscal year ending June 30, 1898. The small amount available is limited to expenditure above the Philadelphia, Wilmington, and Baltimore Railroad Bridge.

It was impracticable to obtain complete commercial statistics.

It is estimated that $20,000 will be required annually for dredging.

July 1, 1897, balance unexpended	$9,822.63
July 1, 1898, balance unexpended	9,822.63
Amount (estimated) required for annual dredging	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix I 9.)

10. *Chester River, Maryland, from Crumpton to Jones Landing.*—This river is a tidal stream 40 miles long, forming the boundary line between Kent and Queen Anne counties, eastern shore of Maryland, and flows

into Chesapeake Bay. It is navigable for vessels drawing 6 feet of water at low tide as far as Crumpton, about 33 miles above the mouth. The least depth of water within the last 7 miles of the river is 3 feet. At Crumpton the average rise of the tide is 2.1 feet. A short distance from this town several shoals have previously been improved by the United States.

The project for improvement is for a 6-foot low-water channel 60 feet wide from Crumpton to Jones Landing, a distance of 6¼ miles, at an estimated cost of $12,750.

Up to the close of the fiscal year ending June 30, 1897, $9,480.90 had been expended and the channel had been improved at various points in accordance with the project.

No work has been done during the past year. The contract for dredging has been extended to December 31, 1898.

The commerce of the river consists mainly of agricultural products. No complete statistics have been obtained, but the Chester River Steamboat Line reports its business for the year on the whole river at 76,119 tons. There is no marked improvement in the commerce to be noted, but the improvements made in the river thus far have facilitated navigation, the extent of which seems to justify the outlay.

July 1, 1897, balance unexpended	$1,519.10
July 1, 1898, balance unexpended	1,519.10
July 1, 1898, amount covered by uncompleted contracts	1,500.00
July 1, 1898, balance available	19.10
Amount (estimated) required for completion of existing project	3,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	3,250.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix I 10.)

11. Choptank River, Maryland.—Before improvements were begun, in 1879, the depth of water in the channel between Denton and Greensboro varied from 2 to 8 feet at low water. Navigation carried on by small sailing vessels extended only to 3 miles above Denton. Upon the remaining 5 miles to Greensboro all freight had to be transported upon scows.

A project for improvement was made in 1880 for an 8-foot low-water channel 75 feet wide, the estimated cost being $79,000. Up to the close of the fiscal year ending June 30, 1897, $50,159.63 had been expended in making a channel not less than 75 feet wide and 7½ feet deep between Greensboro and Brick Mills, a distance of about 4 miles, and to a width of 75 feet and a depth of 8 feet for a farther distance of 1,800 feet below the Brick Mills. The remaining distance to Denton has been partly improved by dredging the channel where needed to depths of 5 and 6 feet, and by widening it to about 40 feet. This leaves somewhat less than 4 miles of this section and several points in the upper river to be dredged to the approved dimensions. Shortly after the main obstructions had been removed in 1887, steamboat communication with Baltimore was established, and since that time commerce has steadily increased. No work has been done during the past fiscal year.

The river and harbor act of June 3, 1896, appropriated $2,000 for continuing this improvement and a contract for dredging has been entered into. The time for completion of the work thereon has been extended to December 31, 1898.

The commerce consists largely of agricultural products and canned goods. The tonnage reported for 1897 is 21,694, valued at $683,871.76.

There has been a marked increase in the commerce of this river since its improvement was begun, and its extent fully justifies the outlay.

July 1, 1897, balance unexpended	$1,840.37
July 1, 1898, balance unexpended	1,840.37
July 1, 1898, amount covered by uncompleted contracts	1,840.37
Amount (estimated) required for completion of existing project	16,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	7,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix I 11.)

12. La Trappe River, Maryland.—This river, formerly called Dividing Creek, is in Talbot County, eastern shore of Maryland, and flows into the Choptank River, one of the larger tributaries of Chesapeake Bay. It is about 3 miles long and has no fresh-water inflow at the head and was originally only 4 feet deep. The entrance to the river was seriously obstructed by several shoal bars, with a least depth of 9 feet in the narrow channel, which was very tortuous and about one-half of a mile long. The average rise of tide is 1.55 feet.

Previous to the adoption of the present project the sum of $5,333.50, raised by private subscription, had been expended in dredging at the head of the river and at the bar at the mouth. The average depth in the river was thereby increased to 8 feet and the channel at the mouth was somewhat widened.

The present project for improvement provides for a channel 150 feet wide and 11 feet deep across the bar at the mouth, and for a channel 75 feet wide and 8 feet deep at mean low water inside the river as far as Trappe Landing, situated at the head of navigation, and a turning basin at the latter point. The estimated cost was $7,250.

Up to the close of the fiscal year ending June 30, 1897, $7,213.87 had been expended and the proposed channel within the river had been completed. The proposed channel at the mouth, about 1,600 feet long, had been dredged to the approved width of 150 feet for a distance of 400 feet, and to a width of 100 feet only for the remaining 1,200 feet. No work has been done during the past fiscal year. The channel in this 1,200 feet, therefore, remains to be widened 50 feet in order to conform to the approved project, and it is estimated that to complete it $2,500 will be required in addition to the amount already expended and originally estimated as the cost of the whole improvement.

In 1893, when the improvement of this river began, the tonnage was 29,094 tons and the valuation $897,450. In 1897 the tonnage reported was 13,958, valued at $431,619. The improvements made thus far have facilitated commerce, but have not increased it.

July 1, 1897, balance unexpended	$36.13
July 1, 1898, balance unexpended	36.13
Amount (estimated) required for completion of existing project	2,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	2,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix I 12.)

13. Warwick River, Maryland.—This river, formerly named Secretary Creek, is in Dorchester County, eastern shore of Maryland, and flows into the Choptank River, one of the larger tributaries of Chesapeake Bay. It is a small tidal basin 2 miles long, with no fresh-water influx at the head, and was originally only 4 feet deep. The average rise of the tide is 1.7 feet.

Before the adoption of the present project about $12,000 had been expended in the improvement of this river, $6,000 by the General Government and the remaining amount by private parties. The present project for improvement, which was proposed in a report on a survey in 1891, provides for a channel 100 feet wide and 10 feet deep at mean low water from the 10-foot depth in Choptank River to Secretary Landing, at the head of the river, including a turning basin at the latter point, at an estimated cost of $18,600.

In 1892–93, beginning in the Choptank River, 4,400 feet of the channel and a portion of the turning basin were dredged to a depth of 10 feet at mean low water; and in 1896 the turning basin was dredged and shoals which had formed at the Mud Flats and Harrisons Gut were removed. There was then no serious obstruction to navigation in the river, and what remained to be done was the widening of the channel in the upper river, about one-third of the whole length, to the approved dimensions. No work was done thereafter to June 30, 1897, to which date $13,918.82 had been expended in the improvement of the river, of which $7,918.82 is on the present project.

Under contract dated December 24, 1896, for the expenditure of the appropriation of $2,000 made by the river and harbor act of June 3, 1896, dredging was begun on June 20, 1898, at a point 400 feet below Cedar Point, and carried on in an up-river direction. The channel, for a distance of 1,900 feet, was made 100 feet wide and 10 feet deep at mean low water, resulting in a channel of the approved dimensions from the Choptank River to Devils Wind Gap. This leaves about 2,050 feet of the channel in the upper river to be dredged to the approved dimensions, and some dredging in the turning basin to complete the project.

The commerce of the river consists mainly of agricultural products. The business of the steamboat line for the year is reported to be 3,709 tons, at a valuation of $126,289. The business done in the river by the numerous sailing vessels could not be obtained. It is believed there has been no material change since the improvements were begun in 1892, but the work has facilitated navigation, the extent of which seems to justify the outlay.

July 1, 1897, balance unexpended		$2,081.18
June 30, 1898, amount expended during fiscal year		528.70
July 1, 1898, balance unexpended		1,552.48
July 1, 1898, outstanding liabilities	$950.00	
July 1, 1898, amount covered by uncompleted contracts	550.00	
		1,500.00
July 1, 1898, balance available		52.48
Amount (estimated) required for completion of existing project		8,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900		4,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix I 13.)

14. Broad Creek River, Delaware.—This river is a tidal stream and a tributary of the east fork of the Nanticoke River, which flows into the Chesapeake Bay.

Before improvements were commenced in 1881 the low-water depth at Laurel was 2 feet; below the town it was in some places only 1½ feet. At the close of the fiscal year 1889, when the original project was completed, at a cost of $35,000, a channel 6 feet deep at mean low water and 50 feet wide had been dredged from Bethel to Laurel, a dis-

tance of nearly 3 miles, and contributed toward making Laurel an important shipping point on the peninsula.

The project for improvement proposed in a report upon an examination made to comply with the requirements of the river and harbor act approved September 19, 1890, provides for dredging a channel 70 feet wide and 8 feet deep at mean low water from Bethel to the head of navigation at Laurel, at an estimated cost of $15,000.

The amount expended on the improvement to the close of the fiscal year 1897 was $45,069.26, of which $35,000 was expended before the adoption of the present project, and $5,000 on the Nanticoke River. At that date a channel of the approved dimensions, 70 feet wide and 8 feet deep at mean low water, had been dredged for a distance of 6,445 feet, beginning at a point 1,000 feet above the bridge at Bethel and ending 680 feet above Hitch's upper wharf, and an additional cut, also 8 feet deep, but only 40 feet wide, was dredged for a length of 215 feet across a shoal situated just beyond the section of the channel that had been dredged to the full width. This was accomplished in 1893, and no work under the project has been done since.

The $5,000 referred to above as expended on the Nanticoke River was applied under the terms of the act of August 18, 1894, to the removal of the bar which extended from the railroad bridge at Seaford toward the mouth of the river.

The river and harbor act of June 3, 1896, appropriated $5,000 for continuing the improvement of Broad Creek River, and contract for its expenditure by dredging has been made, the time as extended for the completion of the work being December 31, 1898.

It has been impracticable to obtain complete commercial statistics. The extent of the known commerce of the river, however, justifies the outlay for the improvement.

July 1, 1897, balance unexpended	$4,930.74
June 30, 1898, amount expended during fiscal year	125.00
July 1, 1898, balance unexpended	4,805.74
July 1, 1898, amount covered by uncompleted contracts	4,805.74
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix I 14.)

15. Nanticoke River, Delaware and Maryland.—This river is a tidal stream, its head waters consisting of numerous branches rising mainly in the northern section of Sussex County, Del. The river flows in a south-southwesterly direction into Tangier Sound, Chesapeake Bay, and the interests for the improvement of the river center at Seaford, 36 miles from the mouth.

The river and harbor act of August 18, 1894, appropriated $5,000 for improving Broad Creek River, Delaware, and provided that as much of it as might be necessary should be used for the removal of the bar extending from the railroad bridge at Seaford toward the mouth of the Nanticoke River. With this appropriation the channel was dredged where necessary to a width of 100 feet and a depth of 9 feet at mean low water, from the south side of the railroad bridge at Seaford to a point 8,000 feet below. A previous appropriation for the Nanticoke River, in 1886, was, in accordance with the terms of the law, applied to the stream known as Broad Creek River, a branch of the Nanticoke River extending to Laurel.

The project for the improvement of the Nanticoke River is based upon a survey made in 1895, and is for a channel 9 feet deep at mean low water and 100 feet wide, the width to be increased to about 150 feet at sharp turns of the channel, the improvements to be extended to within 100 feet of the county bridge, where the proposed channel is to widen out fan shape, at an estimated cost of $13,000.

The act of June 3, 1896, contains the first appropriation ($3,000) for this river, and a contract has been made for work under the approved project. The time on this contract has been extended to December 31, 1898.

The expenditures to June 30, 1897, amounted to $59.12.

The expenditures during the past year were for office expenses.

The shipments for the year are reported to have been 17,015 tons, valued at $682,694.

July 1, 1897, balance unexpended	$2,940.88
June 30, 1898, amount expended during fiscal year	125.00
July 1, 1898, balance unexpended	2,815.88
July 1, 1898, amount covered by uncompleted contracts	2,815.88
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix I 15.)

16. Wicomico River, Maryland.—The portion of the river at and just below Salisbury has been under improvement by the United States since 1872. At that time the navigable channel, with a minimum depth of 8 feet at low water, extended to a point within 2 miles of Salisbury. The extreme upper portion, as far as the milldam in the heart of the town, was quite shoal, and had an average depth of only 18 inches at low tide. Between 1872 and 1885 a channel 75 to nearly 100 feet wide and 7 feet deep at low water was dredged from deep water below to the drawbridge in the town at a cost to the Government of about $50,000.

The present project, based upon a survey of the river made in 1889, provides for a channel 9 feet deep at mean low water from that depth below to the drawbridge at Salisbury, the width to be from 100 to 150 feet, at an estimated cost of $23,200.

On June 30, 1897, $19,473.60 had been expended on the present project, and the channel dredged to the approved dimensions from the drawbridge to opposite Williams Point, about 5,730 feet below. This left about 1 mile to be improved to complete the project. No work has been done during the past fiscal year. The entire amount expended for the improvement of the river to June 30, 1897, is $69,473.60.

The contract for completing the dredging of the river has been extended to December 31, 1898.

The commerce of the river, which is quite varied, is reported for 1897 to have been 147,273 tons, valued at $2,467,729. The improvement thus far made has facilitated navigation and the reports received indicate a marked increase in the commerce of the river.

July 1, 1897, balance unexpended	$3,726.40
June 30, 1898, amount expended during fiscal year	128.20
July 1, 1898, balance unexpended	3,598.20

(See Appendix I 16.)

17. Manokin River, Maryland.—Before improvements were commenced in 1891 the depth of water at the mouth of the river at the so-called "Mud

Flats" was between 1 and 2 feet at low tide. These flats are about 2½ miles wide, and made navigation except at high water impossible, thereby rendering the upper part of the river, which has a very fair depth and width, almost useless for extensive shipping purposes. The average rise of the tide at the flats is 2.6 feet.

The adopted project for improvement is for a channel 6 feet deep at mean low water and 100 feet wide from Locust Point to Sharps Point, embracing the section called the "Mud Flats," at an estimated cost of $30,000.

Up to the close of the fiscal year ending June 30, 1897, $18,975 had been expended, and the proposed channel had been made 80 feet wide for a length of 3,520 feet, beginning at the lower end, and 60 feet wide the remainder of the distance across the "Mud Flats," the depth throughout being 6 feet at mean low water. Several abrupt points in the upper river above Sharps Point had been removed, and navigation upon the whole river at low tide thereby greatly improved. Nothing has been done on the improvement during the past fiscal year, but work will soon be resumed at the mouth, and in dredging in the river between Dashiells Creek and a point known as the Red Bridge or county wharf, under a contract now in operation.

The tonnage in 1891, when work was begun on this improvement, was 144,058 tons, and its valuation $2,282,630. Commercial statistics, stated to be incomplete, for 1896 give a tonnage of 59,704 and a valuation of $2,124,628. None have been received for 1897.

July 1, 1897, balance unexpended	$4,025.00
July 1, 1898, balance unexpended	*4,025.00
July 1, 1898, amount covered by uncompleted contracts	4,025.00
Amount (estimated) required for completion of existing project	9,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix I 17.)

18. Pocomoke River, Maryland.—This river has been under improvement by the General Government since 1878. In 1879 and 1880 $12,500 was expended on work below Snow Hill, chiefly in the rectification of the channel by the turning off of sharp angles and giving increased width, the depth of excavation being to 7 feet at mean low water; and in 1888, with an appropriation of $8,000, a cut-off was made through the low neck of land forming four abrupt bends just below Snow Hill. At the close of these operations there was a channel not less than 80 feet wide and 7 feet deep between Snow Hill and Shad Landing, a distance of about 4⅓ miles.

The present project is based upon a survey made in 1894–95, and is for dredging the channel between Snow Hill and Shad Landing to a depth of 9 feet at mean low water and a width of from 100 to 130 feet, at an estimated cost of $14,000. The amount expended for the improvement of this river to June 30, 1897, is $24,987.26, of which $20,500 was on a former project.

With the appropriation of $5,000 made by the river and harbor act of June 3, 1896, the channel was dredged in 1897 at nine places between Nassawango Creek and the county wharf at Snow Hill, resulting in a 9-foot channel at mean low water, the width varying between 80 and 130 feet.

* Of this amount $2,000 is for work in the upper river not covered by the project.

No work was done during the past fiscal year.

July 1, 1897, balance unexpended	$512.74
July 1, 1898, balance unexpended	512.74
July 1, 1898, outstanding liabilities	373.63
July 1, 1898, balance available	139.11

Amount (estimated) required for completion of existing project	9,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix I 18.)

19. Queenstown Harbor, Maryland.—This harbor was improved by the General Government between the years 1871 and 1880. In the latter year a project for making a channel 100 feet wide and 8 feet deep at mean low water from the Chester River to the inner harbor was completed.

In 1896 Congress appropriated $5,000 for continuing the improvement, and with this appropriation the channel was dredged to a depth of 8½ feet at mean low water, the work being completed in June, 1897. The amount expended to June 30, 1897, was $17,288.73, of which $14,000 was on previous projects.

No work has been done in the past fiscal year. The expenditures were for payment of outstanding liabilities, plotting work, etc.

July 1, 1897, balance unexpended	$1,711.27
June 30, 1898, amount expended during fiscal year	473.75
July 1, 1898, balance unexpended	1,237.52
July 1, 1898, outstanding liabilities	200.00
July 1, 1898, balance available	1,037.52

(See Appendix I 19.)

20. Rockhall Harbor and inner harbor at Rockhall, Md.—The river and harbor act of June 3, 1896, appropriated $9,600 for Rockhall Harbor for completing improvement in accordance with report submitted by Gen. W. P. Craighill, Corps of Engineers, January 7, 1895; also $7,000 for improving inner harbor at Rockhall, in accordance with report submitted by Chief of Engineers in House Ex. Doc. No. 200, Fifty-third Congress, third session.

No work had heretofore been done at the bar outside or in the inner harbor by the General Government.

A project for the expenditure of the appropriations providing for a cut 80 feet in width across the bar and a cut 100 feet wide for the channel inside having been approved, a contract was made for the required work.

Under this contract the cut across Swan Point Bar had been made for a length of 810 feet from the 10-foot curve in Swan Creek, and in the inner harbor a cut had been made 100 feet wide for a length of 1,300 feet, 50 feet wide for a further length of 400 feet, and 25 feet wide for a further length of 200 feet, to the end of June, 1897, at which time the amount expended on the improvement was $699.10.

At the beginning of the fiscal year 1898 operations were in progress in both sections and were continued, with some interruption during the winter, to June 14, 1898. During this time the channel across Swan Point Bar was carried to the 10-foot depth in Chesapeake Bay, and in the inner harbor the channel was carried to the old pier at Rockhall,

and a turning basin embracing both the old and new piers was made at the latter place. The length of the outer cut is 4,600 feet and the width 80 feet, and the width of the inner cut is 100 feet. This completes the project.

The operations have resulted in a continuous 10-foot mean low-water navigation from Rockhall to Chesapeake Bay, shortening the distance to Baltimore considerably.

July 1, 1897, balance unexpended	$15,900.90
June 30, 1898, amount expended during fiscal year	14,752.28
July 1, 1898, balance unexpended	1,148.62
July 1, 1898, outstanding liabilities	1,148.62

(See Appendix I 20.)

21. Removing sunken vessels or craft obstructing or endangering navigation.—Wreck of steamboat Delaware. This vessel, formerly the *Perry*, was a side-wheel steamer 152 feet long, 25 feet beam, and 7½ feet draft, and was sunk in the Christiana River, just above the Baltimore and Ohio Railroad drawbridge, about 60 feet offshore, obstructing navigation. The wreck was blown up with dynamite and the débris placed on shore above high-water mark, at a cost of $533.46. The work was completed in December, 1897.

Wreck of oyster schooner Del May.—This wreck was reported November 13, 1897. Upon examination, it was found lying between Solomons Lump Light and Holland Island Bar Light, in Chesapeake Bay, Maryland. The wreck was blown up and the débris removed and placed above high water. The work was completed February 7, 1898, at a cost of $991.77.

Wreck of scow sunk at Rothwells Landing, in the Smyrna River, Delaware.—This was reported in September, 1897. Operations for its removal were begun on June 29, 1898, and at the close of the fiscal year were still in progress.

Wrecks of barges J. E. Gillingham and Wm. E. Weller.—It was reported in March, 1898, that there were three submerged wrecks at the mouth of Elk River, Maryland, which were endangering navigation. Upon examination, one of these, the *J. E. Gillingham*, was found off Turkey Point; and later, upon further search, the *Wm. E. Weller* was found about a mile distant. Work on the removal of the *J. E. Gillingham* was begun on June 30, 1898, and at the close of the fiscal year was still in progress. The location of wreck *Wm. E. Weller* has been buoyed, and the work of removal suspended for the present under instructions from the War Department.

(See Appendix I 21.)

IMPROVEMENT OF PATAPSCO RIVER AND BALTIMORE HARBOR, MARYLAND.

This district was in the charge of Brig. Gen. Peter C. Hains, U. S. Volunteers, colonel, Corps of Engineers, to October 22, 1897, and from April 1 to June 10, 1898, having under his immediate orders Lieut. Charles W. Kutz, Corps of Engineers, and in the temporary charge of Lieutenant Kutz from October 22, 1897, to April 1, 1898, and since June 10, 1898.

1. Patapsco River and channel to Baltimore, Md.—Seventeen feet at mean low water was originally the governing depth from the deep water of the Chesapeake Bay to Baltimore, and vessels of over that draft were obliged to lighter portions of their cargoes from about 14 miles below to permit them to reach the wharves of the city. There were

pockets where deeper water prevailed, but they were unconnected by any channel, natural or artificial.

To procure a depth of 22 feet at mean low water, with a width of 150 feet, was the original project, and this was adopted in 1853. In 1871 the project was enlarged to the extent of a width of 400 feet at the lower end of the channel, graduated to 250 feet at its upper end, with a mean low-water depth of 24 feet, and this work was completed in 1874, with a change in the position of one part of the channel which shortened the distance and reduced the cost of maintenance. In 1892 a project for 27 feet depth at mean low water with a width of 600 feet in the straight sections and over 1,200 feet in the angles was completed, the work having been authorized in the act of March 3, 1889. Another change was at the same time made in the direction of the channel by excavating what is now known as the Cut-off Division. Appropriations amounting to $100,000 were made for the maintenance of the channel dredged under this latter project.

A channel 30 feet deep at mean low water, with a bottom width of 600 feet, widened in the angles, and with side slopes of three base to one vertical, from Fort McHenry to the deep water of Chesapeake Bay, was provided for in the act of June 3, 1896, and this is the existing project, approved by the Secretary of War July 10, 1896. The estimated cost is $2,500,000, with an annual expenditure of $50,000 for maintenance.

The amount expended on this improvement up to the close of the fiscal year ending June 30, 1897, was $3,333,303.23.

With $450,000 provided by the act of June 3, 1896, work was commenced on the existing project. A cut has been made in the middle of the 27-foot channel, carrying it to 30 feet depth at mean low water. This cut is 230 feet wide in the Fort McHenry, Brewerton, and Craighill divisions and 250 feet wide in the Cut-off Division. There is now a continuous channel 30 feet deep at mean low water from the deep water of the bay to Fort McHenry, but its width is not sufficient to afford much relief to the commerce of the port.

There has been an increase of $107,687,375 in the value of the annual commerce since the commencement of this improvement.

The tonnage movement of the port has been as follows:

Fiscal year ending June 30—	Tons.	Fiscal year ending June—	Tons.
1889	3,243,017	1894	4,752,946
1890	4,237,361	1895	4,794,964
1891	4,495,469	1896	5,363,894
1892	5,224,042	1897	6,868,120
1893	4,607,176	1898	7,339,405

July 1, 1897, balance unexpended	$382,726.77
June 30, 1898, amount expended during fiscal year	312,586.05
July 1, 1898, balance unexpended	70,140.72
July 1, 1898, outstanding liabilities	49,054.38
July 1, 1898, balance available	21,086.34
Amount (estimated) required for completion of existing project	2,100,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	400,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix J 1.)

2. *Channel to Curtis Bay, in Patapsco River, Baltimore Harbor, Maryland.*—Curtis Bay was originally a nearly circular harbor, about 4

miles below the city of Baltimore, with a natural depth of 22 feet at mean low water. It required connection with the main ship channel to Baltimore to be available for the deep-draft vessels using the port.

The originally adopted project (Annual Report, Chief of Engineers, 1893, p. 1249) was for a channel 150 feet wide at bottom and a depth of 27 feet at mean low water from the main ship channel in the Patapsco River to Curtis Bay, at a cost of $85,000. A channel of that width, but of 25 feet depth, was completed in 1893 with an appropriation of $28,000, made in 1892.

The amount expended up to the close of the fiscal year ending June 30, 1897, was $28,000.

The channel dredged answers all present needs of the navigation and commerce of the bay, and the appropriation of $12,000 in the act of August 18, 1894, is unexpended.

Nothing was expended in the fiscal year ending June 30, 1898, and the channel remains with the same dimensions as at June 30, 1897.

Curtis Bay is in the collection district of Baltimore. Owing to the destruction by fire of a sugar refinery there, its commerce has not increased since the existing channel was completed, although the refinery has been reconstructed.

July 1, 1897, balance unexpended	$12,000.00
July 1, 1898, balance unexpended	12,000.00

(See Appendix J 2.)

3. *Harbor of southwest Baltimore (Spring Garden), Md.*—The original condition of the navigable channel way was that it had a controlling depth of 15 feet at mean low water in one portion, although the depth was greater in others. The width was contracted, but varying, the least being about 100 feet. Navigation was not available for the deep-draft vessels of the port of Baltimore.

The originally adopted project (Annual Report, Chief of Engineers, 1896, pp. 1005, 1006, and 1007) was for a channel 27 feet deep at mean low water, 100 feet wide at bottom, with side slopes of 1 on 3, from the main ship channel near Fort McHenry to the foot of Eutaw street, with a turning basin 400 by 400 feet near the upper end, at an estimated cost of $314,000.

There had been no expenditures up to the close of the fiscal year ending June 30, 1897.

The condition of the improvement June 30, 1897, is as stated in the first paragraph.

There were no operations in the fiscal year ending June 30, 1898, the appropriation of $5,000, in the act of June 3, 1896, being too small to accomplish any useful result.

This harbor is in the collection district of Baltimore, and the commercial statistics of that port include it.

Amount appropriated by act of June 3, 1896	$5,000.00
July 1, 1898, balance unexpended	5,000.00
Amount (estimated) required for completion of existing project	309,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix J 3.)

4. *Removing sunken vessels or craft obstructing or endangering navigation—Schooners Three Brothers and Fleming.*—These vessels were sunk in the Chesapeake Bay, the former August 30, 1897, in the ship channel leading to the port of Baltimore, and the latter August 3, 1897, near it.

Both were obstructions to navigation. They were removed by purchase of material in open market and hire of labor, the work being completed November 18, 1897, at a total cost of $156.87.

(See Appendix J 4.)

IMPROVEMENT OF POTOMAC RIVER AND ITS TRIBUTARIES, OF JAMES RIVER, VIRGINIA, AND OF CERTAIN RIVERS IN VIRGINIA ON WESTERN SHORE OF CHESAPEAKE BAY.—PROTECTION OF JAMESTOWN ISLAND, VIRGINIA.

This district was in the charge of Lieut. Col. Chas. J. Allen, Corps of Engineers, with Maj. J. J. Morrow, U. S. Volunteers, first lieutenant, Corps of Engineers, under his immediate orders.

1. Potomac River at Washington, D. C.—The Potomac River is navigable for vessels, both steam and sail, from its mouth to Georgetown, D. C., a distance of 113 miles. At Washington it changes its character from a distinctly fluvial to a tidal stream. The tide rises as far up as Little Falls, 3 miles above Georgetown, but the flood current is not perceptible above the latter. The mean range of tides at Washington is 3 feet.

At Little Falls, the actual head of navigation, the width of the river at low tide is 150 feet. The width just above the Aqueduct Bridge, which crosses the river at Georgetown, is about 1,200 feet. Below this bridge, along the water front of Georgetown, the width of the river gradually decreases for a distance of one-half mile to the foot of Thirty-first street, where the width is 730 feet. This part of the river is known as Georgetown Harbor, and its navigation was formerly obstructed by several dangerous rocks, which were removed in 1876 and 1883–1885. The depth obtained over these rocks by the improvement was 20 feet at low tide, which is now the ruling depth in the harbor. Georgetown has a wharf frontage of 4,000 feet, extending from the Aqueduct Bridge to the mouth of Rock Creek. At Easbys Point, 1 mile below the bridge, the river width is 974 feet. Prior to the reclamation of the flats the width of river sharply increased from Easbys Point to about 6,000 feet off the foot of Seventeenth street, about four-fifths of a mile below, and this last-named width substantially continued to Giesboro Point, nearly 4 miles below Easbys. Over a great part of this width there was a large deposit of the sediment carried by the river, resulting in the formation of bars in the channel and of wide flats on the left bank.

There were, in 1792, three channels in this part of the river, but since 1834 there have been but two, viz, the main, formerly called the Georgetown, but now known as the Virginia Channel, and the Washington Channel.

Long Bridge, 1¼ miles below Easbys Point, crosses both channels. The Virginia Channel was obstructed by two bars. The upper bar extended from Long Bridge to about one-half mile below Easbys Point. The ruling depth on this bar was 8 feet in 1857, while in 1871 it was 10 feet; in 1873 it was 13½ feet, and in 1881 15 feet. The improvement was due to frequent dredging, but after every freshet the dredged channel was nearly obliterated. The lower bar, 3,200 feet long, was near Giesboro Point, and in 1874 had a ruling depth of 14 feet, which was increased by dredging in 1874–75 to 16 feet. This was the ruling depth in 1881. Between these two bars the channel had depths of 20 to 30 feet. Below Long Bridge the Washington Channel was shoal; its ruling depth in 1878 was 10 feet for the greater part of the wharf front. Off the foot of N street the depth increased to 12 feet, thence gradually deepened to 22

feet off Greenleaf Point where the Anacostia River enters the Potomac.

The depth in the Washington Channel had been increased by dredging, so that in 1881 a depth of 16 feet could be found along the greater part of the wharf front.

The flats, which, under the conditions above noted, had, prior to the present project, been in gradual process of formation for a long time, extended from the Washington shore to the edge of the Virginia Channel. Between Easbys Point and the old Seventeenth street wharf a large area, in some places 1,500 feet wide, had been raised by accretions to a height of about a foot above mean low tide. Large quantities of sewage were carried at high tide over these flats and distributed by the flow among the rank growth of sedges and aquatic plants with which the flats were covered. As the tide fell this mass of sewage was left exposed to the rays of the sun. These conditions combined to generate effluvia which rendered the adjacent portions of the city almost uninhabitable, and at the same time were reported as causing malarial and other diseases.

The present, which is the original, project for improvement was adopted by the act of Congress of August 2, 1882. It has for its object the improvement of the navigation of the river by widening and deepening its channels, reclamation of the flats by depositing on them the material dredged from the channels, the freeing of the Washington Channel, so far as it can be done, of sewage, and the establishment of harbor lines beyond which no wharves shall be built. To effect these the project provided for 20 feet depth in the channels at low water, for filling in the flats to a height of 3 feet above the flood plane of 1877, and for a tidal reservoir or basin above Long Bridge, to be provided with inlet and outlet gates of ample dimensions, to work automatically, and so arranged as to admit of the basin being filled from the Virginia Channel on the flood tide and discharged into the Washington Channel on the ebb. An ample system of drainage for the reclaimed area was also contemplated.

A training dike on the Virginia shore, extending downstream from the foot of Analostan Island, was added to the project in 1890.

The project also provides for the rebuilding of Long Bridge at an early period during the progress of the improvement, with wide spans upon piers offering the least possible obstruction to the flow of the water and the interception of all sewage now discharged into the Washington Channel and its conveyance to the James Creek sewer canal, but neither of these works was included in the estimated cost of the improvement, which was $2,716,365. The estimate, as revised in 1897, is $2,953,020.

The total of appropriations for this improvement from August 2, 1882, to June 3, 1896 (the date of the last appropriation), is $2,285,000.

The amount expended to include June 30, 1897, was $2,162,493.84. The expenditure resulted in the dredging of a channel 20 feet deep and 550 feet wide through the bar above Long Bridge and in restoring the standard 20-foot navigation by redredging shoals due to freshets; in increasing the width of the natural channel just below Long Bridge by 50 to 500 feet and in deepening it to 20 feet; in dredging a channel 350 feet wide and 20 feet deep through the bar in the Virginia Channel near Giesboro Point; in dredging the Washington Channel to a width of 400 feet and a depth of 20 feet for a navigation channel, and in dredging between this navigation channel and the wall of the adjacent reclaimed area to a depth of 12 feet; in dredging at the junction

of the Washington and Virginia channels; in dredging the tidal reservoir (111 acres) to a depth of about 8 feet; in the construction of the reservoir outlet and in construction of 35,289 linear feet of sea wall and 5,965 linear feet of training dike.

During the past fiscal year a part of the old sea wall of Section III, along the Washington Channel at the lower end of the flats, was relaid. This work was done by hired labor. A small amount of dredging, by contract, was also done in the Virginia Channel. The contract was made March 9, 1897, for dredging to be done under the appropriation of $100,000 made June 3, 1896, for this improvement. The contract work was to commence on or before July 1, 1897, and be completed on or before October 1, 1898. Several attempts were made by the contractor to start his dredge, but without success, and at the end of the fiscal year no further dredge work had been accomplished.

No dredging of importance having been done in the Virginia Channel since 1894, the depth above Long Bridge has decreased in places, owing to deposit of material from freshets, and, as a result, deeeply laden vessels bound to or from Georgetown are at present obliged to wait for the flood tide, or to lighter, in order to be able to proceed to their destinations. Dredging will remedy this. With the exception of the present difficulty in the Virginia Channel, the benefits to commerce and navigation from the improvement have been marked. Vessels using the channels have been loaded more heavily than could formerly be done. The value of the commerce to be benefited may be judged by examination of the following table showing the commerce of the port of Washington, in tons, from 1887 to 1897, inclusive:

	Tons.		Tons.
1887	618,972	1893	653,433
1888	581,575	1894	644,588
1889	488,680	1895	693,450
1890	519,696	1896	723,657
1891	551,219	1897	523,498
1892	766,954		

The sum asked for the fiscal year ending June 30, 1900, is to be applied to work in furtherance of the project.

Congress, by act approved March 3, 1897, set aside the reclaimed flats, together with the tidal reservoirs, as a public park under the name of the Potomac Park, to be forever held and used as a park for the recreation and pleasure of the people.

July 1, 1897, balance unexpended	$122,506.16
June 30, 1898, amount expended during fiscal year	24,266.52
July 1, 1898, balance unexpended	98,239.64
July 1, 1898, outstanding liabilities	441.00
July 1, 1898, balance available	97,798.64

Amount (estimated) required for completion of existing project	668,020.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix K 1.)

2. Occoquan Creek, Virginia.—Occoquan Creek is a tributary of the Potomac River, which it enters about 25 miles below Washington, D.C. The stream is navigable from its mouth at Sandy Point to the town of Occoquan, a distance of 4 miles. Navigation was obstructed by four bars, which were improved between 1873 and 1880 by dredging and dike construction, so as to secure a navigable depth of about 6 feet at

low tide. Four appropriations were made from 1873 to 1878, amounting to $25,000, and in 1880 the improvement was regarded as completed. In compliance with the provisions of the river and harbor act of August 11, 1888, a new survey of the creek was made in 1889. The survey showed that of the channels dredged through Lower Mud, Upper Mud, Sand, and Occoquan bars, all, excepting that dredged through Upper Mud Bar, had filled in from 2 to 3 feet in depth since 1880. The act of September 19, 1890, appropriated $10,000 for improving the creek.

The project adopted December 5, 1890, for the new (present) improvement comprises dredging of channels 6 feet deep and from 100 to 150 feet wide through the four bars and construction of dikes required to secure the depths obtained by dredging. Estimated cost of the project, $45,000.

The total of appropriations for the improvement from September 19, 1890, to and including June 3, 1896, is $22,500.

The amount expended upon the improvement, to include June 30, 1897, was $20,035. It resulted in the dredging of channels from 100 to 150 feet in width and from 6 to 8 feet in depth through the four bars named, and in constructing a total of 1,585 linear feet of dike.

A small amount of dredging was done during the season of 1897.

The expenditures to June 30, 1898, resulted in securing a depth of 6 feet through all the bars to the town of Occoquan.

The work remaining to be done to complete the project is extension of the dike at Sand Bar, construction of a dike at Upper Mud, and such dredging as may be necessary to restore the channel dimensions called for by the project. Owing to the action of freshets in the upper part, and to the great width of the lower part of the stream and cross tidal currents in the latter, it is probable that occasional redredging will be required to maintain the depth even after the essential features of the project shall be completed. The project is not, therefore, regarded as capable of permanent completion as regards dredging.

The sum of $4,000 can be profitably expended during the fiscal year ending June 30, 1900, in extension and construction of dikes and in dredging.

The work done under the appropriations for this improvement has been of material benefit to the trade and commerce connected with this locality by increasing the original ruling depth of 3 feet at low tide to 6 feet, thus obviating the delays due to waiting for tides and increasing the available draft of vessels navigating the creek. In this connection attention is invited to the comparative table of commercial statistics appended to this report. The articles carried through the channel are mostly sand (for building), railroad ties, piles, and wood; coal, fertilizers, flour, and grain, and miscellaneous articles, being small in amount:

Receipts and shipments by water.

Year.	Tons.
1891	8,205
1892	56,705
1894	8,900
1895	10,475
1896	41,670
1897	15,835
Total for six years	141,790

Of the total tonnage 81,400 tons was sand.

July 1, 1897, balance unexpended	$2,465.00
June 30, 1898, amount expended during fiscal year	2,395.98
July 1, 1898, balance unexpended	69.02

Amount (estimated) required for completion of existing project	22,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	4,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix K 2.)

3. Aquia Creek, Virginia.—This creek enters the Potomac River 41 miles below Washington. It is navigable to Wharton Landing, about 7½ miles above its mouth. The creek has a well-defined channel 60 to 200 feet wide in its upper part; the depth was originally 2 to 17 feet. At a point about 4½ miles above the mouth, called the Narrows, the stream suddenly expands into a bay 1,000 to 6,000 feet wide, resulting in a continuous shoal, on which the depth ranged generally from 2 to 4 feet, increasing to 7 feet near the mouth. About 3 miles above the mouth the creek is crossed by a trestle bridge of the Richmond, Fredericksburg and Potomac Railroad. The bridge has a draw 28 feet wide.

From 1872 to 1878, both years inclusive, Congress appropriated $10,500 for improving the creek. The amount was expended in dredging between Davis Point, one-third mile below the bridge, and Wharton Landing.

A new survey was authorized by the river and harbor act of August 11, 1888, and made in 1889. It showed that considerable filling had occurred below the railroad bridge.

The result of this survey was the adoption of a new project, approved December 4, 1890, providing for the dredging of a channel 80 feet wide and to a depth of 6 feet, where less than that depth existed between the mouth and the Narrows. The cost of the project was estimated as $40,000, but it was afterwards reduced to $21,000.

The amount expended under this project to include June 30, 1897, was $17,412.10. The work done under this expenditure resulted in a channel 6 feet deep and 80 feet wide through the greater part of the shoal between the mouth and a point one-fourth of a mile below the Narrows, a total distance of 4¼ miles.

Under the appropriation of June 3, 1896, the channel was dredged during the season of 1897, the result being a completed channel 80 feet wide and 6 feet deep between the mouth of the creek and the Narrows. This work completed the project, consequently no further appropriation is needed.

The work done has been of benefit to the existing trade of the creek by enabling vessels trading there to pass the long shoal below the Narrows into the upper part of the creek.

The trade of the creek is chiefly in tobacco and railroad ties; 8,000 tons of the former and 10,000 of the latter are reported as among the shipments for 1895, the statistics for that year being the latest available.

The total of appropriations applicable to the project of 1890 amounts to $21,000, of which $20,287.39 was expended to the close of the fiscal year 1898.

July 1, 1897, balance unexpended	$3,587.90
June 30, 1898, amount expended during fiscal year	2,875.29
July 1, 1898, balance unexpended	712.61
July 1, 1898, outstanding liabilities	65.00
July 1, 1898, balance available	647.61

(See Appendix K 3.)

4. Nomini Creek, Virginia.—Nomini Creek enters the Potomac River from the right bank about 82 miles below Washington. In 1872 its navigation was obstructed by a bar of oyster shells and sand at its mouth, over which but 3 feet could be carried at low tide. There was a strong cross current just within the mouth. After passing the bar the stream widens, and 8 feet can be carried for about 3½ miles to Nomini Ferry, while 5 feet can be carried for about 6 miles above the mouth.

The project for improvement, adopted in 1873, provided for dredging a channel through the bar 100 feet wide and 9 feet deep. The width was increased to 150 feet in 1879 in order to meet the increased trade. In 1885 the project was again modified by increasing the proposed width to 200 feet at a cost of $62,500. In 1888 the estimate was increased to $72,500, the channel having shoaled on account of suspension of work from 1883 to 1889. It was difficult to secure permanent results, the channel being exposed to north and northwest winds and to cross-tidal currents. The deterioration of the channel outside White Point was thought to be largely due to material carried into the channel by the flood and ebb currents of Currioman Bay. In order to maintain the channel, the project was modified in 1890 to embrace the following: The dredged channel to be 150 feet wide and 9 feet deep, a jetty to be constructed from White Point on the east and one from Cedar Island on the west, dikes to be built inside White Point to check the cross-currents; estimated revised cost, $72,500. Examination made in 1897 showed that the east jetty should be made 400 feet longer, and that both jetties should be made higher than originally projected, the increased cost bringing the estimate up to $105,000.

The amount expended to June 30, 1897, was $57,511.36. It resulted in the excavation of a channel 150 feet wide and 9 feet deep and the construction of 819 linear feet of the east jetty. The channel inside and near White Point Shoal had shoaled slightly, while the outer channel had shoaled about one foot. The ruling depth through the channel at low tide was 8 feet.

During the fiscal year ending June 30, 1898, the outer channel was redredged, as far as the available funds would permit, and the standard depth of 9 feet restored in the greater part of the channel, though the ruling depth is 8 feet. The work was done by contract.

The total of freight transported through the channels under improvement, 1889–1897, is 186,470 tons. The freight carried was coal, farm produce, grain, lumber, oysters, railroad ties, general merchandise, and wood. The tonnage by years is given below.

The work required for completion of the project is completion of the east jetty, construction of the west jetty, and some redredging of the channels.

The sum asked for the fiscal year ending June 30, 1900, is to be applied to jetty construction and dredging.

Tonnage by years.

Year.	Tons.	Year.	Tons.
1889	13,542	1894	25,100
1890	15,825	1895	16,250
1891	62,300	1896	7,425
1892	a21,000	1897	7,370
1893	17,658		

a This statement is for sailing vessels only. The steamers carry the great bulk of grain and merchandise.

July 1, 1897, balance unexpended	$2,488.64
June 30, 1898, amount expended during fiscal year	2,426.79
July 1, 1898, balance unexpended	61.85

Amount (estimated) required for completion of existing project	45,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	6,000.00

(See Appendix K 4.)

5. *Lower Machodoc Creek, Virginia.*—This creek is a tidal estuary on the right bank of the Potomac River and about 85 miles below Washington, D. C. It has a navigable length of about 4 miles. The width between banks at the mouth is 1 mile, and between the 12-foot contours the channel width exceeds 3,000 feet. The lower part of the creek, for a distance of 1½ miles above the mouth, is three-fourths of a mile to 1 mile in width, with a navigable depth of 13 feet, affording a safe harbor during northeast to southeast storms.

At the Narrows, 2 miles above the mouth, the stream suddenly contracts to a width of 650 feet, and the channel is obstructed by a sand bar over which but 4 feet could be carried at low tide. This bar constituted the principal obstruction to navigation.

After passing Narrows Bar a depth of 10 to 14 feet is found in the channel, gradually shoaling to about 9 feet near "Cupelo Point," 3 miles above the mouth, and thence to about 6 feet at Drum Bay, the head of navigation, 4 miles above the mouth.

The present approved project, adopted November 29, 1892, provides for dredging a channel 150 feet wide and 9 feet deep at low tide through the bar at the Narrows, at an estimated cost of $15,000.

The total of appropriations, to include that of $1,500 by act of June 3, 1896, is $7,500.

The total amount expended to include June 30, 1897, was $5,934.40. It resulted in a channel through Narrows Bar 150 feet wide and 6 feet deep on the sides, a depth of 9 feet existing over a width of 85 to 110 feet in midchannel.

During the past fiscal year the 9-foot channel was widened on the left side and some shoals, which had formed since the previous dredging, were removed. Owing to the small appropriation the amount of dredging was limited. Upon its completion the width of the 9-foot channel was from 90 to 110 feet.

The benefit to navigation and commerce from the work done is somewhat prospective, for the reason that the bar, through which dredging has been done, completely closed the creek to steamers, and it has only been since April, 1896, that they have been enabled to enter the creek.

Repeated efforts have been made to obtain commercial statistics for this work, but without success.

July 1, 1897, balance unexpended	$1,565.60
June 30, 1898, amount expended during fiscal year	1,472.30
July 1, 1898, balance unexpended	93.30

Amount (estimated) required for completion of existing project	7,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	3,000.00

(See Appendix K 5.)

6. *Rappahannock River, Virginia.*—The Rappahannock River is navigable from its mouth in Chesapeake Bay to Fredericksburg, Va., a

distance of 106 miles. The lower part of the river has the character of a tidal estuary, the width varying from 1 to 3.5 miles. The ruling depth at the mouth is 5 fathoms, and this depth holds to Jones Point, 28 miles above, while 17 feet can be carried to within 1 mile of Tappahannock, which is 41 miles from the mouth. Above Tappahannock the river has a tortuous course, and above Port Royal, 29 miles from Fredericksburg, it flows between high banks. The width at Fredericksburg is about 350 feet, gradually increasing to about 1,500 feet at Port Royal. In 1871, prior to the inception of the improvement, 6 feet could be carried to within a mile of Fredericksburg, and thence 4 feet to the town.

The obstructions to navigation before improvement was undertaken were nine bars between Tappahannock and Fredericksburg, over which the ruling depths were from 4 to 10½ feet. The chief obstructions were in the 12½ miles of river below Fredericksburg, and where seven of the bars were found. Of these bars, Fredericksburg Bar, with a least depth of 4 feet, and Spottswood Bar, 4 miles below Fredericksburg, with a least depth of 6 feet, caused the most delay to steamboats and vessels.

The original project, approved in 1871, was to secure a channel 100 feet wide and 10 feet deep by dredging and the construction of dikes from Fredericksburg to Tappahannock, the wrecks obstructing the channel to be removed. The first estimate of the cost of this improvement was $83,760. In 1879 the project was amended so as to provide for dredging a channel 100 feet wide and 10 feet deep through the bars between Fredericksburg and Port Royal, and one 200 feet wide and 15 feet deep between Port Royal and Tappahannock, for a larger class of vessels; the depths secured by dredging to be maintained by a system of wing dams and training dikes, to be built of piles and sheet piling, or of piles and brush or logs, the dikes being also required in some cases to secure the dredged material from being carried back into the river.

The total cost of the revised project, which is the present approved project, was estimated as $381,500.

The appropriations for this work from March 3, 1871, to June 3, 1896, aggregate $252,500.

The total amount expended to June 30, 1897, was $242,547.37. The results of the expenditure were the partial improvement of seven bars between Fredericksburg and Port Royal by means of dredging, and construction of dikes and the removal of all wrecks which obstructed navigation.

During the past fiscal year proposals were invited for dredging at Fredericksburg Bar and for rock excavation near the lower end of the bar, in connection with dredging proposed at Urbana Creek. But one proposal was received, and the price for dredging at Fredericksburg Bar was so high that the bid was rejected. The work will be again offered for contract in July.

The work already done has been of material relief to existing navigation in enabling vessels which were formerly detained at Spottswood Bar, 4 miles below Fredericksburg, to reach the latter at all stages of the tide.

A draft of 9 feet or more can now be carried over the bars below Fredericksburg, Spottswood Bar excepted, where the ruling depth is 8.2 feet. At Fredericksburg Bar, the head of navigation and a few miles below the head of tide water, new deposits of sand are formed by each recurring freshet, and the annual reports for a number of years past have referred to the necessity of an annual appropriation of $7,500 for removal of such deposits.

The work remaining to complete the project is continuation of dredging and dike construction necessary to secure the required dimensions of channel.

The value of the improvement may be inferred from an examination of the following table of commercial statistics:

Tonnage for—	Tons.	Tonnage for—	Tons.
1888	83,600	1894	*144,070
1890	83,830	1895	*151,466
1892	*126,333	1896	*161,196
1893	*141,750	1897	*158,108

The principal articles of commerce are grain, oysters, fertilizers, cattle, farm produce, and general merchandise.

The sum of $10,000 is estimated for the fiscal year ending June 30, 1900, to be expended in dredging and dike work at the bars just below Fredericksburg.

July 1, 1897, balance unexpended	$9,952.63
June 30, 1898, amount expended during fiscal year	63.01
July 1, 1898, balance unexpended	9,889.62
July 1, 1898, outstanding liabilities	1.12
July 1, 1898, balance available	9,888.50
Amount (estimated) required for completion of existing project	129,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix K 6.)

7. *Urbana Creek, Virginia.*—Urbana Creek enters Rappahannock River from the right bank at a point about 16 miles above its mouth. In 1874 a bar existed outside the mouth over which but 6½ feet depth could be carried at low tide. In 1882 a shoal within the creek, having a least depth of 7 feet, and near the town of Urbana, was regarded as obstructing steamboat navigation.

The project for improvement adopted in 1879 comprised excavation of a channel 150 feet wide and 10 feet deep through the outer bar. Estimated cost, $20,000. This project was modified in 1883 to include dredging through the inner bar and in 1888 to include jetties at the mouth to maintain the channel. The revised estimated cost was $34,580.

On account of the exposed position of the channel through the outer bar the work suffered from the action of northwesterly winds, which caused shoaling in the channel and a diminution in its width. In April, 1897, a survey was made to determine the extent of change in the channels and an estimate rendered in June following of the cost of completing the project by dredging and construction of a jetty to protect the channel dredged through the outer bar. This cost, added to the amounts expended to date, increases the estimated cost of the present project to $70,000.

The appropriations for this work from March 3, 1879, to June 3, 1896, aggregate $30,500. The amount expended to June 30, 1897, was $27,540.90. It resulted in a channel 10 feet deep and from 130 to 150 feet in width through the outer bar and a channel 10 feet deep and 80 to 170 feet wide at the shoal within the creek, although recent examinations indicate some deterioration of the latter-named channel.

In August, 1897, proposals were invited, by public advertisement, for

* Furnished by Mr. William D. Scott, Fredericksburg, Va.

dredging in connection with proposed dredging and rock excavation in the Rappahannock near Fredericksburg, all the work to be done under a single contract. The bid received, however, was so high in one of the items that the proposal was rejected. Further action was then deferred until the working season of 1898. The work will be again offered in July for contract.

The improvement has been of benefit to commerce and navigation by permitting the entrance of sailing vessels to the creek and enabling one of the steamers of the Weems Line, Baltimore to Fredericksburg, to enter the creek and land at the wharf.

The value of the commerce and navigation of the stream is indicated by the following table of commercial statistics:

Commercial statistics.

Calendar year—	Reported by Mr. F. A. Bristow.	Reported by Mr. J. D. Gresaitt.
	Tons.	*Tons.*
1891	19,500	22,100
1892	20,095	17,125
1893	55,885	61,290
1894	82,395	88,305
1895	66,530	92,320
1896	137,485	133,925
1897	153,875	181,500

The principal articles of commerce are oysters, tobacco, railroad ties, coal, grain, and lumber.

The sum of $10,000, asked for the fiscal year ending June 30, 1900, is to be expended in dredging and in commencing the construction of the jetty for maintaining the depth in the outer channel.

July 1, 1897, balance unexpended	$2,959.10
June 30, 1898, amount expended during fiscal year	18.54
July 1, 1898, balance unexpended	2,940.56
Amount (estimated) required for completion of existing project	39,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix K 7.)

8. *York River, Virginia.*—York River is 41 miles long and discharges into Chesapeake Bay about 16 miles above Old Point. Entering the river, 24 feet can be carried for 32 miles, or up to Potopotank Bar, 9 miles below Westpoint. In 1880 the ruling depth on this bar was 18.5 feet. Westpoint Bar, the next obstruction to navigation, commences about 2 miles below and extends up to Westpoint. Before improvement it had a ruling depth of 15.5 feet.

The original project for improvement, adopted in 1880, proposed dredging channels 22 feet deep and 200 feet wide through the bars. In 1884, on account of growth of trade, the width was increased to 400 feet, and in 1887 the project was further amended to include construction of a dike along the right bank at Westpoint Bar to maintain the channel. Total cost of the revised, which is the present, project, $308,800.

Total amount expended to June 30, 1897, $211,778.12. It resulted in a dredged channel 105 feet wide and 22 feet deep at Potopotank and one 22 feet deep and 160 to 260 feet in width at Westpoint Bar. This

latter channel narrowed and shoaled and had to be redredged. A training dike 7,639 feet long was constructed at Westpoint Bar, at which point the last dredging was done in 1895. An examination made in April, 1897, of the work at this bar showed that the part of the channel dredged in 1895 was in serviceable condition, it being 22 feet or more in depth and 150 to 200 feet wide, the dike evidently having the desired effect. An examination of the channel made in June, 1898, also showed continued favorable action of the dike.

The ruling depth from the sea to Westpoint may be stated as 20 feet at low tide.

A large and important commerce has been benefited by this improvement. Westpoint has been for years the cotton-shipping point for the Southern Railway Company, and in 1894 there were shipped at this port 72,235 tons of cotton and 206,706 tons of general merchandise. The total of shipments for that year, as reported, was 379,808 tons. Seven hundred and fifty-eight arrivals and clearances of steamers drawing over 10 feet were reported for that year.

The Southern Railway Company in 1896 established a new terminal and shipping point at Norfolk, Va., and freight carrying on the river is reported as having fallen off considerably in consequence of the transfer.

Efforts have been made to procure commercial statistics for years subsequent to 1894, but without success.

In view of the present, at least, falling off in commerce the views of those regarded as most directly interested in the navigation of the river were sought as to the present needs, in the way of width and depth of channels, of vessels navigating the river. The weight of opinion appeared to be that the improvement should proceed notwithstanding the transfer of the said terminal and shipping facilities. Attention is invited to the correspondence in this connection attached to Appendix J 8 of the Annual Report of 1897.

In view of the present changed conditions the officer in charge suggested the policy of maintaining the channels already dredged so that, whenever required, work under the full project might be resumed. Extension of the Westpoint Dike and dredging are recommended, and the sum asked for the fiscal year ending June 30, 1900, is to be applied to that work.

The funds appropriated by the act of June 3, 1896, will be applied this season to work under the project.

July 1, 1897, balance unexpended	$17,971.88
June 30, 1898, amount expended during fiscal year	306.50
July 1, 1898, balance unexpended	17,665.38
July 1, 1898, outstanding liabilities	29.17
July 1, 1898, balance available	17,636.21
Amount (estimated) required for completion of existing project	79,050.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix K 8.)

9. *Mattaponi River, Virginia.*—The Mattaponi is navigable for small steamers and vessels from its mouth to Aylett, about 39 miles, and can be made navigable for small barges from Aylett to Monday Bridge, 16 miles. The obstructions to a 5½-foot navigation below Aylett consist of seven bars, upon which the ruling depths at low tide vary from 2.4

to 3.8 feet. Above Aylett there are numerous bars, but no work on them has been proposed. The river was also obstructed by snags, overhanging trees, and wrecks.

The original project for improvement, adopted in 1880, provided for removal of snags, leaning trees, and wrecks below Monday Bridge and the improvement of the bars below Aylett, so as to give a depth of 5½ feet at low tide and a channel width of 40 feet. This project was extended by the terms of the river and harbor act of July 13, 1892, which provided for the removal of snags as far up as Guineas Bridge, near Milford Station, on the Richmond, Fredericksburg and Potomac Railroad. Estimated cost of project, $72,100.

From June 14, 1880, to June 3, 1896, both dates inclusive, appropriations aggregating $29,800 were made for this improvement. Of this amount there was expended to June 30, 1897, the sum of $24,794.21, which resulted in the removal of snags, logs, and overhanging trees from the river between Robinson Bar and Monday Bridge, and in keeping the river below Aylett free from such obstructions, and also in the construction of 2,297 linear feet of dike at Robinson Bar.

Proposals for dredging were invited in June, 1897, but no bids were received. Proposals were again invited in August last. But one bid was received, which was rejected as too high in price. Further action was then deferred until conditions should be more favorable.

The work already done upon this river has been of benefit to the existing commerce, for the amount of which reference is made to Appendix K 9. As snags and other obstructions form in greater or less degree after every freshet, much of the work done has had to be gone over again. Before any work for improvement was undertaken the trade was limited.

The sum of $3,000, estimated for the fiscal year ending June 30, 1900, is to be applied to continuance of work under the existing project.

The work remaining to be done under the project consists in completion of the dikes at Robinson Bar, construction of those required at Latané Bar, dredging, and removal of snags and fallen timber, which accumulate more or less every year.

July 1, 1897, balance unexpended	$5,005.79
June 30, 1898, amount expended during fiscal year	89.73
July 1, 1898, balance unexpended	4,916.06
Amount (estimated) required for completion of existing project	42,300.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	3,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix K 9.)

10. Pamunkey River, Virginia.—The Pamunkey River is navigable from its mouth at Westpoint, on York River, to Hanovertown, a distance of about 59 miles. Seven feet of depth at low water can be carried to Buckland Bar, 38½ miles above Westpoint. Above this bar are six bars extending along the river for about 15¼ miles, the ruling depths on which vary from 5½ to 1½ feet, excepting on the Upper or Indian Table Bar, which is exposed at low tide. Besides these bars are logs, snags, and overhanging trees.

The project for improvement, adopted in 1880 and amended in 1885, contemplated 7-foot navigation to Bassett Ferry, 47 miles from Westpoint; thence 5 feet to Wormley Landing, 54 miles; thence 3 feet to Hanovertown, the 7-foot channel to have a width of 100 and the other channels 40 feet. The wrecks, snags, logs, and trees obstructing navi-

gation between Garlick Ferry and Hanovertown were also to be removed. The cost of this amended project, which is the present project, was estimated at $32,500.

The total expenditure to June 30, 1897, was $21,817.16. It resulted in removing several times snags and similar obstructions from about 30 miles of river, in removing parts of seven wrecks, and in partly improving Spring and Skidmore bars, 43 and 47 miles, respectively, from Westpoint.

No field work was done during the past fiscal year. In June, 1897, proposals were invited by public advertisement for dredging at Buckland Bar. No bid was received. The work was again offered for contract by public advertisement, dated August 25, 1897, resulting in but one bid being received, which was rejected as too high. Further action was deferred until conditions should be more favorable.

The commerce of this river amounted, according to reports received, to 50,420 tons in 1893, and 42,250 tons in 1894, the greater part of the latter being railroad ties and wood. There is scarcely any trade on the 5 miles below Hanovertown. Commercial statistics for years subsequent to 1894 could not be obtained.

The work remaining to be done to complete the existing project consists in dredging, construction of dikes, and removal of snags and logs. The sum of $3,000, estimated for the fiscal year ending June 30, 1900, is to be applied to that work.

July 1, 1897, balance unexpended	$3,682.84
June 30, 1898, amount expended during fiscal year	34.85
July 1, 1898, balance unexpended	3,647.99
Amount (estimated) required for completion of existing project	7,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	3,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix K 10.)

11. James River, Virginia.—Prior to 1870 a small sum had been expended with some advantage to navigation, but the improvement was not regularly undertaken by the United States until that year. The obstructions to navigation existing in 1870 consisted of artificial as well as natural ones. The artificial obstructions had been placed in the river during the war of 1861–1865 to prevent the national fleets from reaching Richmond. These consisted of sunken vessels and other impediments. There were also remains of military bridges.

The depths at mean low water in 1870, before operations commenced, were as follows:

Locality.	Distances.	Depths.
	Miles.	*Feet.*
Richmond to Goodes Rocks	2	8
Goodes Rocks	.25	7
Richmond Bar	.75	7
Richmond Bar to Drewry Bluff	3.75	9
Drewry Bluff to Curles	14	a 7
Curles to Hampton Roads	30	14.8

a In bend at Dutch Gap, now avoided by Dutch Gap Cut-off.

The original project was to give 18 feet depth at full tide to Richmond, with a channel width of 180 feet from Harrisons Bar to the city docks, the excavation in rock to be 18½ feet. The average rise of tide is 2½ feet. Work on this project was well advanced when Congress, July

5, 1884, adopted another of 22 feet at mean low tide from Richmond to the sea. The width to be given the channel is 400 feet from the sea to Citypoint, 300 feet from there to Drewry Bluff, and thence 200 feet to Richmond, estimated to cost $4,500,000. A large part of the excavation has been and will be in solid rock, and the cost is necessarily great. Operations consist in dredging, rock excavation, and the contraction and regulation of the waterway by means of dikes and jetties.

The amount expended on the improvement, to include June 30, 1897, was $1,702,530.11, with the result that 16½ feet at low tide could be carried from the sea to the lower city limits of Richmond.

The work during the past fiscal year has consisted in earth, cobble, and hard and soft rock excavation and in building and repairing wing dams. Two thousand nine hundred and twenty-six cubic yards of earth, 362 of cobble, 7,024 of soft rock, and 3,387 of solid rock were excavated during the year, and 1,562 linear feet of timber and 127 of stone wing dams constructed, raised, repaired, and extended. The material excavated from the channel was used in revetment or extension of the wing dams.

There is now a channel 100 feet wide and 18 feet deep at mean low tide from Hampton Roads to within 775 feet of the Richmond city line. Above that point and to within 170 feet of the city line a depth of about 18 feet at full tide can be carried, though the width is less than 100 feet. A saving of about 5½ miles of difficult river was effected several years ago by opening Dutch Gap Cut-off.

The value to commerce of this improvement can be appreciated by examination of the statistical table herewith, giving the total tonnage of the river between the years 1890 and 1897:

	Tons.		Tons.
1890	743,122	1894	616,269
1891	739,308	1895	602,582
1892	616,755	1896	680,935
1893	663,625	1897	661,909

The principal articles of commerce are coal, building materials, fertilizers, ice, iron, lumber, ties, tobacco, and general merchandise.

The sum asked for the fiscal year ending June 30, 1900, is to be applied to rock excavation, dredging, dike work, etc., in accordance with the project.

The conditions of this work are such that the best and most economical results for the United States can be obtained from liberal appropriations.

July 1, 1897, balance unexpended		$69,969.89
June 30, 1898, amount expended during fiscal year		50,130.73
July 1, 1898, balance unexpended		19,839.16
July 1, 1898, outstanding liabilities	$1,100.00	
July 1, 1898, amount covered by uncompleted contracts	8,050.00	
		9,150.00
July 1, 1898, balance available		10,689.16
Amount (estimated) required for completion of existing project		3,467,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900		150,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix K 11.)

12. Protection of Jamestown Island, Virginia.—The river and harbor act of 1894 contained an item of $10,000 for protection of Jamestown Island. *The shore had been wearing* away for years from action of

waves, and the erosion had reached a point where protection was required if the old landmark was to be preserved. The appropriation was applied to construction of a wall faced with granite laid without mortar in front of the threatened portion of the island, to grading and turfing the bank behind the wall, and to construction of several groins in front of it. This work was completed in 1895.

The soil of the island is light and easily moved. The funds did not admit of covering the part requiring protection with the kind of work desirable. Storms, especially those of the winter of 1895 and 1896, greatly damaged the work.

The river and harbor act of June 3, 1896, appropriated $15,000 for this protection. The work for protection will be resumed as soon as satisfactory preliminary arrangements with regard to occupation of the ground are made. The reasons for such arrangements not having been accomplished thus far are given in Appendix K 12 of this report.

The work will consist principally of regrading the bank and levee where necessary and covering it with a slope wall of large stone laid in cement mortar, the toe of the wall to be protected by riprap so far as the funds will admit of.

The following are the amounts and dates of appropriations for protecting Jamestown Island, Virginia:

August 18, 1894	$10,000.00
June 3, 1896	15,000.00
Total	25,000.00
July 1, 1897, balance unexpended	15,725.55
July 1, 1898, balance unexpended	15,725.55

(See Appendix K 12.)

13. Removing sunken vessels or craft obstructing or endangering navigation—Wreck of schooner Kate Lawson in Urbana Creek, Virginia.—This wreck having been reported as injurious to navigation, an examination of the same was made in July, 1897. The officer in charge having reported on August 5, 1897, that the wreck was an obstruction to navigation, an allotment of $250 was made August 7, 1897, from the indefinite appropriation for removing sunken vessels or craft obstructing navigation. On September 2, 1897, the usual notice to parties interested in the wreck was given by public advertisement and proposals invited for its removal. The bids received were too high, and the officer in charge was authorized to reject them and do the work by hired labor. The United States snag boat, which was to be used for the purpose, was detained last fall on other important work which could not be relinquished. It was the intention to employ the boat last spring in removing the wreck, but the prospect of war with Spain made it absolutely necessary to keep the boat in the Potomac for certain work in connection with the defenses of Washington.

The wreck will be removed early in the coming fiscal year.

(See Appendix K 13.)

PROJECT FOR THE IMPROVEMENT OF ANACOSTIA RIVER AND THE RECLAMATION OF ITS FLATS.

The joint resolution of Congress providing for the improvement of Anacostia River, approved April 11, 1898, calls for a project and estimate for the improvement of the river and the reclamation of its flats between the District line and the mouth of the river, and also for cer-

tain information in regard to the ownership of the flats and the cost of acquiring any lands owned by private parties. The resolution made an appropriation of $2,000 for the surveys required.

The duty of preparing the project and report called for by the resolution was assigned to the charge of Lieut. Col. Chas. J. Allen, Corps of Engineers, by letter of the Chief of Engineers May 2, 1898.

The necessary surveys and examinations of the ground and inspection of maps and records are in progress and a report and project will be rendered early in the coming fiscal year.

IMPROVEMENT OF NORFOLK HARBOR, VIRGINIA, AND ITS APPROACHES, AND OF RIVERS AND HARBORS IN SOUTHEASTERN VIRGINIA AND NORTHEASTERN NORTH CAROLINA.

This district was in the charge of Capt. Thomas L. Casey, Corps of Engineers, having under his immediate orders Lieut. Edward H. Schulz, Corps of Engineers, from April 9, 1898, to May 19, 1898. Division Engineer, Brig. Gen. Peter C. Hains, U. S. Volunteers, colonel, Corps of Engineers.

1. Harbor at Norfolk and its approaches, Virginia.—Before the present project of improvement was begun, in 1877, the harbor of Norfolk was obstructed by shoals at the mouths of the Eastern and Southern branches, the shoal in the Eastern Branch being about one-third of a mile long, with a low-water depth of 15 to 16 feet, that in the Southern Branch being short and with a depth of 22 to 23 feet.

The approaches to the harbor were obstructed by shoals at Sewall Point, 3 miles long, having a low-water depth of 20 feet, and at the mouth of the Western Branch, 1 mile long, with a low-water depth of 19 feet. The depths of these shoals and the widths of the channels, particularly in the inner harbor, where encroached upon by the Portsmouth and Berkley flats, were insufficient for the requirements of the port.

The plan of improvement adopted in 1878 was to deepen and widen the channels at the mouth of the Southern Branch and along Portsmouth and Berkley flats in the harbor proper, and to improve the approaches to the harbor by dredging a channel 500 feet wide and 25 feet deep at ordinary low water through the shoals at Sewall Point and at the mouth of the Western Branch.

The revised project of 1885 is as follows: (1) To dredge a channel not less than 500 feet wide and 25 feet deep at ordinary low water from the deep water in Hampton Roads to Norfolk and the United States navy-yard, on the Southern Branch, and also to dredge a channel in the Eastern Branch not less than 22 feet deep at ordinary low water, with a width of 700 feet at its mouth, and of not less than 300 feet at the Norfolk and Western Railroad Bridge; (2) to ultimately dredge the entire area bounded by lines parallel to and 75 feet from the port-warden lines to a depth not less than 25 feet from Fort Norfolk to the United States navy-yard, and not less than 22 feet from the mouth of the Eastern Branch to Campostella Bridge, and to build a bulkhead at Berkley Flats.

To the project of 1885 there was added in 1890, under authority of the river and harbor act of that year, the dredging of an anchorage at the mouth of the Western Branch, with a depth of not less than 25 feet at ordinary low water, at an estimated cost of $150,000, which amount was added to the original estimate, making the total estimated cost of the improvement $1,041,774.56.

The amount expended on this improvement to June 30, 1897, was $976,836.76. At that date, a channel with a depth of 25 feet at mean low water existed from Hampton Roads to the United States navy-yard, on the Southern Branch, except between Fort Norfolk and Lambert Point, where the 25-foot channel has contracted somewhat. Nowhere is this channel less than 500 feet in width. In the Eastern Branch to the Norfolk and Western Railroad Bridge the channel is from 500 to 1,050 feet wide and its depth 22 feet at mean low water. An anchorage has been provided of about 75½ acres, 58½ of which it was necessary to dredge to 25 feet at mean low water, the other 17 acres being made available by the dredging.

These channels are not sufficient to accommodate the commerce of the harbor, and a channel 300 feet wide, 30 feet deep at mean low water, is urgently needed. With the present channel the larger vessels of the United States Navy are unable, at low tide, to reach the navy-yard, on the Southern Branch. Merchant vessels drawing from 26 to 27 feet of water frequently sail from the harbor loaded for foreign ports, leaving on high water. Another improvement of the harbor, which is desirable and necessary for widening the channel at about the narrowest and busiest part of the harbor, is the cutting off of 400 feet of Hospital Point. Full information concerning the latter is given on pages 1355 to 1364, Annual Report of the Chief of Engineers, Part II, 1897.

Shoaling has been observed in only two instances, in the mouth of the Eastern Branch due no doubt to sewage discharged at that point from the main pipe of the Norfolk sewerage system, and on the eastern side of the channel between Fort Norfolk and Lambert Point, which has probably been caused by the settlement of the material stirred up by a suction dredge employed in dredging slips at Pinner Point. The channel in the mouth of the Eastern Branch was redredged under the last appropriation, but nothing has been done as yet toward removing the latter shoaling, as it does not interfere seriously with navigation.

During the fiscal year ending June 30, 1898, the expenditures amounted to $4,444.02, which includes expenses of running and maintaining the steamer *Lucerne*, which it was necessary to keep in commission to look after the interests of the harbor, for use in locating new piers, investigating complaints, keeping up permanent bench marks and transit stations, and in making necessary examinations to keep the maps of the improvement up to date.

The abutment of the old toll bridge in the Eastern Branch, for the removal of which bids were asked by public notice dated June 22, 1897, still remains, as the limited amount of funds available for the work was exceeded by all bids received July 9, 1898, the lowest of which was $6,015.

On June 30, 1898, a vessel drawing 25 feet could at mean low water reach the United States navy-yard, on the Southern Branch, which is the farthest point from Hampton Roads within the limits of the project. The average tide is about 2.7 feet, which would allow of 27.7 feet navition at that stage.

The deficiency act approved July 7, 1898, appropriates $360,000 for securing a channel not less than 450 feet wide and 28 feet deep from Hampton Roads to the United States navy-yard at Portsmouth, and it is proposed to do the required dredging by contract.

The commerce was reported for the calendar year 1896 at 5,013,185 tons; that for 1897 is stated at 9,430,526 tons.

July 1, 1897, balance unexpended	$8,163.24
June 30, 1898, amount expended during fiscal year	4,444.02
July 1, 1898, balance unexpended	3,719.22
Amount appropriated by deficiency act of July 7, 1898	360,000.00
July 7, 1898, balance available	363,719.22
Amount (estimated) required for completion of existing project	56,774.56
Amount that can be profitably expended in fiscal year ending June 30, 1900	25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix L 1.)

2. *Western Branch of Elizabeth River, Virginia.*—The appropriation made in the act of June 3, 1896, amounting to $45,000, was for completing the improvement proposed for the river.

The channel of the river, when funds were provided, was from 50 to 300 feet wide and 12 feet deep at mean low water.

The project adopted was to obtain a channel 200 feet wide and 20 feet deep at mean low water from a similar depth in Norfolk Harbor for a distance of about 1 mile, or to within about 300 feet of the bridge crossing the river between Port Norfolk and West Norfolk, at a cost of $45,000.

To June 30, 1897, the expenditures on account of this improvement amounted to $27,752.50, and at that date a channel 200 feet wide for 3,400 feet and 160 feet wide for an additional 1,450 feet had been dredged to a depth of 20 feet at mean low water.

During the fiscal year ending June 30, 1898, the sum of $16,666.23 was expended for dredging, inspection, and office expenses.

Under a contract 103,996 cubic yards of material was dredged, at 8.4 cents per cubic yard, scow measurement. This resulted in three cuts each 40 feet in width and 1,500 feet long and one cut of the same width 1,160 feet long; also, in cutting back the point at the entrance from Norfolk Harbor for 200 feet.

The channel proposed for the improvement has been secured, at a cost of $40,490.78 for dredging. Whether it will remain as dredged is doubted, and the funds available will be used in making an examination to determine the extent and location of the shoaling.

On June 30, 1898, a vessel drawing 20 feet could pass through the channel at mean low water.

During the calendar year 1896 the commerce of the stream was stated to be 211,653 tons; for the calendar year 1897 it was 244,803 tons.

July 1, 1897, balance unexpended	$17,247.50
June 30, 1898, amount expended during fiscal year	16,666.23
July 1, 1898, balance unexpended	581.27

(See Appendix L 2.)

3. *Nansemond River, Virginia.*—In 1872 this river was navigable at low water over the course of the river covered by the present project by boats drawing 5 feet. The channel way was, however, badly obstructed by wrecks and snags.

The sum of $37,000 was expended between 1873 and 1878 in securing a channel 8 feet deep at mean low water from the mouth of the river to Suffolk, Va.

The present adopted plan of improvement is to secure a channel not less than 100 feet wide at bottom, 12 feet deep at mean low water, from the head of navigation to the mouth of the Western Branch, 5.37

miles, including a turning basin 200 feet square 300 feet below Suffolk Bridge, by dredging and by the construction of spurs and training walls; and a channel of like depth from the mouth of the Western Branch to deep water at Town Point, 200 feet wide at bottom at its upper end and gradually increasing to at least 400 feet at its lower end, etc., the total estimated cost being, in round numbers, $152,500.

On June 30, 1897, $40,082.87 had been expended under the present project, channels being dredged through shoals between Suffolk and the Western Branch, about 5.37 miles below, giving a channel 80 feet wide and 12 feet deep at mean low water to the latter point. A turning basin 300 feet below the bridge at Suffolk has also been provided. The channel is in fair condition and no complaints have been received during the fiscal year 1898.

No operations were carried on during the fiscal year ending June 30, 1898.

At the close of the fiscal year a boat drawing 12 feet of water could go to Suffolk, the head of navigation, at mean low water.

The commerce as reported for the calendar year 1897 shows a decrease of 17,905 tons when compared with the amount reported for 1896.

July 1, 1897, balance unexpended	$4,917.13
June 30, 1898, amount expended during fiscal year	12.50
July 1, 1898, balance unexpended	4,904.63
Amount (estimated) required for completion of existing project	107,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix L 3.)

4. *Appomattox River, Virginia.*—This river was navigable at high water for vessels drawing about 6½ feet, before its improvement, as far as Petersburg, 11 miles from the mouth at Citypoint, Va. This channel was tortuous, and numerous shoals limited to that degree the draft that could safely be carried into the river.

The project for this improvement, adopted in 1870, provided for obtaining, by dredging shoals and the construction of contracting works, a channel 12 feet deep at mean high water, and of such width as was thought could be maintained by the tidal flow. The estimated cost of this work was $423,830, and in addition $10,000 annually for the maintenance of the channel and contracting works. It being desirable to extend the contracting works contemplated under the original project, the estimate was, by authority of the Chief of Engineers, increased to $473,920 in 1893.

The amount expended on the improvement to June 30, 1897, was $429,239.34.

By 1875 a channel 60 feet wide and 12 feet deep at mean high water had been secured from Petersburg to Point of Rocks, by dredging such shoals as required it, and by making a cut-off called "Puddledock Cut." This channel was subsequently increased to 80 feet. Numerous shoals formed by freshets have been dredged and regulating and contracting works built.

The expenditures during the fiscal year ending June 30, 1898, amounted to $472.12 for care of plant and office expenses.

The channel depth at the close of the fiscal year will allow a vessel of 9 feet draft to reach Petersburg at mean high water.

The commerce of the river during the calendar year 1897 amounted

to 84,031 tons, an increase of 2,713 tons when compared with statement submitted for calendar year 1896.

July 1, 1897, balance unexpended	$4,590.66
June 30, 1898, amount expended during fiscal year	472.12
July 1, 1898, balance unexpended	4,118.54

Amount (estimated) required for completion of existing project	48,090.00
Amount (estimated) required for maintenance annually	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, including maintenance	23,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix L 4.)

5. *Harbor at Cape Charles City, Va.*—This harbor is an artificial rectangular basin of about 10 acres area, originally excavated to a depth of 12 feet in a pond just back of the shore of Chesapeake Bay, about 12 miles north of Cape Charles. It is in Northampton County, and forms the shore terminus of the New York, Philadelphia and Norfolk Railroad Company, transfer of passengers and freight being made by boat to and from Norfolk, Va. The tide rises on an average about 2.6 feet.

The adopted project provides for dredging the harbor to a depth of 14 feet and the entrance thereto and the channels in Cherrystone Inlet and across Cherrystone Bar to a depth of 16 feet at mean low water, the width at the inlet and bar to be 100 and 200 feet, respectively, protecting the channel entering the basin by two stone jetties, one on the north side and the other on the south side. The dredging was estimated to cost $45,400 and the jetties $84,000, with $12,940 for contingencies.

The expenditures for this improvement to June 30, 1897, amounted to $34,907.46, with the result that about one-half of the area of the harbor was given a depth of 14 feet at mean low water, the entrance deepened to 16 feet at the same stage of the tide, and the shoal in Cherrystone Inlet partly removed. The jetty on the north side of the entrance has been built from the shore outward for a distance of 1,150 feet, 750 feet of which was constructed without expense to the United States by the New York, Philadelphia and Norfolk Railroad Company. The entrance channel, which was unprotected prior to 1897, has shoaled considerably since it was deepened and has been redredged.

The expenditures, which amounted to $75, during the fiscal year ending June 30, 1898, were for payment of outstanding liabilities at end of last fiscal year.

Complaint has been made of shoaling in the channels in the bay and at the entrance, which has shoaled to about 13 feet at mean low water, and this is the maximum draft that could be carried into the harbor on June 30, 1898.

No replies were received to the inquiries made in regard to the commerce of this harbor during the calendar year 1897.

July 1, 1897, balance unexpended	$92.54
June 30, 1898, amount expended during fiscal year	75.00
July 1, 1898, balance unexpended	17.54

Amount (estimated) required for completion of existing project	107,340.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix L 5.)

6. Nandua Creek, Virginia.—Nandua Creek is an arm of Chesapeake Bay, extending about 7 miles into the eastern shore of the bay, 26 miles north of Cherrystone Light.

A survey of the creek was made to comply with the river and harbor act of August 18, 1894, and a report thereon submitted June 17, 1895. In this report it was stated that a channel across the bar at the mouth, 100 feet wide and 8 feet deep at mean low water, would cost about $6,000.

When the survey was made a channel of ample width and depth existed within the creek, a bar at the mouth with a least depth of 5 feet at mean low water preventing greater draft being carried into the channel.

No action has been taken by the Secretary of War on the project submitted for the expenditure of the appropriation of $3,000 in the act of June 3, 1896, for this improvement, consequently no work has been done.

The expenditures during the fiscal year ending June 30, 1898, amounted to $11.92, the cost of an inspection made of the creek by the district engineer.

The position of the channel at the entrance changes with each severe storm, but the depth is not generally affected thereby. It is supposed to be at least as great as when the survey was made in 1895.

The commerce for the calendar year 1897 shows a decrease of 2,689 tons when compared with the amount reported for 1896.

July 1, 1897, balance unexpended	$3,000.00
June 30, 1898, amount expended during fiscal year	11.92
July 1, 1898, balance unexpended	2,988.08

(See Appendix L 6.)

7. Inland water route from Norfolk, Va., to Albemarle Sound, North Carolina, through Currituck Sound.—This route is composed of the following bodies of water, viz: Elizabeth River, North Landing River, Currituck Sound, Coanjock Bay, North River, and the Albemarle and Chesapeake Canal. All are natural waterways with the exception of the canal, which is owned and controlled by a corporation. The canal proper has one lock, and extends from the head of the Southern Branch of the Elizabeth River to North Landing Bridge, a distance of 8.44 miles.

The original condition of the route permitted its navigation by boats drawing 5 feet of water. In some parts a draft of 7 feet could be carried. This channel was badly obstructed by overhanging growth, snags, sunken logs, and sharp bends in the rivers.

Prior to the river and harbor act of September 19, 1890, the improvement was carried on under projects for each part of the route, and to June 30, 1897, an aggregate of $240,169.69 had been expended on the separate works in an endeavor to secure a navigable channel, free from all obstructions, 80 feet wide and 9 feet deep. The channels at that time were from 25 to 80 feet wide and 8 to 9 feet deep.

The separate projects were primarily to obtain a 9-foot channel 80 feet wide throughout the entire route by dredging, removing obstructions, and constructing a dike in Coanjock Bay. When the consolidation was made the object of the separate projects was not altered, and the combined estimated cost of these projects remained the same. The latter was $306,667.08.

Since the consolidated project was adopted $30,112.57 had been

expended thereunder to June 30, 1897, in widening the channels to the projected dimensions and in redredging in the Southern Branch of the Elizabeth River.

During the fiscal year ending June 30, 1898, $7,418.06 was expended.

Under a contract 29,062 cubic yards of material was removed by dredging from the Southern Branch of the Elizabeth River. From the Albemarle and Chesapeake Canal locks to a point 1,700 feet below dredging was carried over a width of 60 feet, and for an additional distance of 1,300 feet one cut 20 feet wide was made on each side of the existing channel. At the sharp bend near the Green Sea Railroad wharf one cut 20 feet wide was made on each side of the channel for a distance of 1,900 feet. The contract price was 23 cents per cubic yard for material deposited from scows.

On June 30, 1898, a draft of from 8½ to 9 feet could be carried through the part of the route under improvement. The depth in the canal, however, is not over 8 feet, and with northerly winds this is decreased by from 6 inches to 1 foot. There is no tidal flow in these waters, except in the Elizabeth River, but a wind from the direction stated drives the water out of the canal and rivers to the southward.

The commerce for the calendar year 1897 shows a decrease of 21,892 tons when compared with the amount reported for 1896.

July 1, 1897, balance unexpended	$8,887.43
June 30, 1898, amount expended during fiscal year	7,418.06
July 1, 1898, balance unexpended	1,469.37
Amount (estimated) required for completion of existing project	29,667.08
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix L 7.)

8. *Roanoke River, North Carolina.*—In 1872, before the improvement of this stream, a draft of 10 feet could be carried to Indian Highland Bar, 67 miles from the mouth, and 5 feet to Weldon, except during periods of low water, when it was limited to from 2 to 3 feet. In the part of the river below Indian Highland Bar wrecks and other obstructions placed during the civil war interfered with navigation, and the channel above was badly obstructed by snags, logs, stumps, and overhanging trees.

The project adopted provides for obtaining an unobstructed channel at all seasons of the year, 50 feet wide at its narrowest point from Hamilton to Weldon, 5 feet deep at low water, and for removing obstructions from the channel below Hamilton to a depth suitable for vessels navigating the sounds of North Carolina. The estimated cost of the work contemplated under the project amounted to $269,000.

To June 30, 1897, $189,796.49 had been expended on the project and an unobstructed 10-foot channel as far as Hamilton and a 5-foot channel at extreme low water from that point to Weldon, except in a few shoal places where the depth was only 4 feet, was secured.

There was expended on account of this improvement during the fiscal year ending June 30, 1898, the sum of $3,847.50 for repairs to snag boat and removing obstructions from the channel between Hamilton and Weldon. These obstructions consisted of 116 trees, 13 logs, 19 stumps, 11 snags, and 13 overhanging trees, which were trimmed.

The available depth of the channel on June 30, 1898, is 10 feet to Hamilton at extreme low water and 4 feet from that place to Weldon.

A full statement of the commerce of the river has not been obtained since 1893, although efforts are made each year to secure the information.

July 1, 1897, balance unexpended	$39,541.51
June 30, 1898, amount expended during fiscal year	3,847.50
July 1, 1898, balance unexpended	35,694.01

(See Appendix L 8.)

9. Pasquotank River, North Carolina.—The depth of the channel of this river when the improvement was started in 1891 was 7 feet up to the southern terminus of Turners Cut, about 12 miles above Elizabeth City, N. C. In the Moccasin Track, a tributary of the river, about 1,100 feet above its junction with the stream, a depth of 5 feet exists, and from that point to Lebanon Bridge the channel is obstructed by snags, stumps, and overhanging trees.

The original project of 1889 was first to clear the 5 miles of channel in the river and Moccasin Track from the lower end of Turners Cut to the original terminus of the canal, and, second, to clear out the river 6 miles farther to Lebanon Bridge for navigation by pole or flat boats, at an estimated cost of $9,000.

The above project was modified August 3, 1892, so that the funds appropriated should be expended in securing an unobstructed channel below Turners Cut for boats of 3 feet draft.

The sum of $4,644.23 had been expended to June 30, 1897, in removing obstructions from the channel. At that date few obstructions existed, but the undergrowth on many points of bends below Turners Cut obstructed the vision of the next reach of the river.

During the fiscal year ending June 30, 1898, $2,398.45 was expended on the improvement. Of this, $1,949.72 was expended in trimming points in bends and removing obstructions. The work was done by the crew of the snag boat *Roanoke* from August 8, 1897, to November 30, 1897, 167 cords of brush being cut and 32 logs, 5 trees, 8 stumps, and 6 piles taken from the channel. This work was done between Opossum Quarter and Turners Cut and in the lower part of the Moccasin Track.

At the end of the fiscal year a depth of about 9 feet exists to the lower end of Turners Cut, and thence to the canal locks and Lebanon Bridge the depth is about 4 feet.

It is not possible to obtain accurate statistics of the commerce which is carried on mostly in small boats making irregular trips. Two small steamers make biweekly trips from Elizabeth City to South Mills, and carry products of the farms adjacent to the river for shipment to markets.

July 1, 1897, balance unexpended	$2,403.02
June 30, 1898, amount expended during fiscal year	2,398.45
July 1, 1898, balance unexpended	4.57

(See Appendix L 9.)

10. Removing sunken vessels or craft obstructing or endangering navigation.—Wreck of steamer Wyanoke—The contractor for the removal of this wreck, after making two unsuccessful attempts to raise the vessel by means of inflated air sacks, abandoned this method January 28, 1898, and on February 10, 1898, proceeded to blow the wreck to pieces. This he accomplished by exploding 5 tons of dynamite in charges of from 700 to 50 pounds.

The débris scattered by the explosive was raised to the surface by a derricked barge. About 900 tons of material was raised in this manner and discharged from the barge to a dock at Newport News, Va. This was completed May 15, 1898.

On examination of the locality a depth of 55 to 65 feet at mean low water was found, and no obstruction to anchorage was noticed. The work being satisfactory in every respect the contractor was paid.

The removal of this wreck cost $17,811.32.

Wreck of steamer Helen Smith.—After inviting bids by public notice, this work was awarded to William T. White, the lowest bidder, at $100.50, who raised the wreck by pontoons. In towing the wreck to shoal water the chains slipped from the hull and the wreck went down in 25 feet of water, when he abandoned it.

Britton & Wilson, the next lowest bidders, agreed to do the work for the amount of their bid, and were authorized to proceed.

After attempting to raise the wreck they resorted to the use of explosives, and had the wreck removed by October 15, 1897.

The cost of the work was $205.88.

Wreck of Schooner A. D. Lamson—This was the wreck of a three-masted wooden schooner which sank after collision with the steamship *Rappahannock* in 31 feet of water, about 6 miles east by north out from Cape Henry Light.

Verbal offers of local firms were obtained, and Mr. Henry Seymour, of Norfolk, Va., was engaged to do the work. The work was performed between October 3, 1897, and November 4, 1897.

The cost of the removal of this wreck was $1,500.

Wreck of schooner Walker Armington.—This wreck lay in 29 feet of water, south 68° 31′ east (magnetic) from Thimble Shoal Light in Chesapeake Bay and about 2½ miles therefrom. The wreck being a dangerous obstruction to navigation its removal was authorized December 2, 1897.

After advertisement by public notice, Messrs. Virden & Ross, of Lewes, Del., entered into a contract under date of January 1, 1898, to do the work. This contract was faithfully carried out between January 13, 1898, and February 4, 1898, the wreck being broken up.

The cost of the work was $3,191.13.

(See Appendix L 10.)

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN NORTH CAROLINA.

This district was in the charge of Capt. W. E. Craighill, Corps of Engineers, having under his immediate orders Lieut. Edgar Jadwin, Corps of Engineers, to October 12, 1897, and Additional Second Lieut. John C. Oakes, Corps of Engineers, since September 30, 1897. Division Engineer, Brig. Gen. Peter C. Hains, U. S. Volunteers, colonel, Corps of Engineers.

1. Ocracoke Inlet, North Carolina.—In 1828 vessels drawing 9 feet could cross the ocean bar at low water, but immediately within the inlet not more than 5 feet could be carried.

The project of 1827 was to dredge a cut 10 feet deep at high water and 400 feet wide at the head of Wallace Channel. Between 1830 and 1837 the depth was increased 3½ feet by the expenditure of $133,732.40,* when the improvement was abandoned.

*In addition to this amount, $17.60 was carried to the surplus fund.

The controlling depth at mean low water over the inner shoals was 7½ feet in 1891 and 1894, and the depth at the ocean entrance to the inlet was 14 feet in 1891 and 1892 and 12 feet in 1894.

The project of 1889 was to dredge a channel 300 feet wide through the shoals within this inlet at an estimated cost, if 10 feet deep, of $100,000; if 13 feet deep, of $190,000, or if 15 feet deep, of $280,000, and to protect the channel so dredged by such training walls or protecting dikes as may possibly prove necessary, at an estimated additional cost of $320,000.

July 9, 1894, the project was again modified to provide for dredging cuts 9 feet deep at mean low water and 300 feet wide, about 5,000 feet long at the head of Wallace Channel and about 700 feet long in Beacon Island Slough, at an estimated cost of $51,513.39, to obtain a channel 9 feet deep from the inlet through the inner shoals to Pamlico Sound.

To the close of the fiscal year ending June 30, 1897, the total expenditures for this locality amounted to $221,349.37.

At that date the project of July 9, 1894, had been completed.

A survey made in January, 1898, shows that Beacon Island Slough cut has shoaled to approximately its original condition.

Royal Shoal cut has shoaled only slightly, principally at the sides. The least available depth is 7 feet.

The commerce during 1897 amounted to 43,741 tons, a decrease of 6,259 tons from that of last year.

No transportation lines were established during the year.

July 1, 1897, balance unexpended	$17,383.03
June 30, 1898, amount expended during fiscal year	1,093.59
July 1, 1898, balance unexpended	16,289.44

(See Appendix M 1.)

2. Fishing Creek, North Carolina.—From its confluence with the Tar River, 94 miles above Pamlico Sound, up to the Wilmington and Weldon Railroad Bridge, Fishing Creek is from 35 to 150 feet wide, with controlling channel depth on its bars of 3 feet at the average high-water stage of winter and spring. It is obstructed by many snags.

The project of 1889 as modified in 1896 is to clear out the natural obstructions up to the Wilmington and Weldon Railroad Bridge, at an estimated cost of $22,750, and to maintain the improvement.

The amount expended on this improvement up to June 30, 1897, was $5,685.55.

The acts making appropriations provide that the money should not become available until draws were provided in such bridges as were, in the opinion of the engineer in charge, unreasonable obstructions to navigation.

On June 30, 1897, commencing at its mouth, for about 12 miles the channel had been cleared of logs and snags and the banks for the same distance cleared of overhanging trees and brush likely to obstruct navigation.

By the expenditures of the fiscal year ending June 30, 1898, the creek was cleared for a farther distance of about 7 miles.

The creek is only navigable during freshets.

The commerce during 1897 amounted to 2,460 tons, a gain of 1,460 tons since last year.

No transportation lines were established during the year.

It is estimated that $1,500 will be required for maintenance of the improvement during fiscal year ending June 30, 1900.

July 1, 1897, balance unexpended	$9,314.45
June 30, 1898, amount expended during fiscal year	6,686.29
July 1, 1898, balance unexpended	2,628.16
July 1, 1898, outstanding liabilities	62.50
July 1, 1898, balance available	2,565.66
Amount (estimated) required for completion of existing project	7,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, for continuing improvement	7,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement	1,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix M 2.)

3. Pamlico and Tar rivers, North Carolina.—(One river, called the Pamlico below and the Tar above Washington.) When the United States began to improve it, in 1877, its channel was obstructed by piles, wrecks, and bars. Between Washington and Tarboro the available depth exceeded 2 to 3 feet not more than eight months annually, and above Washington the entire river was more or less obstructed by snags, logs, and stumps in the channel and by trees overhanging from its banks.

The project is that adopted in 1875, to secure by dredging and removal of war obstructions a clear and safe channel 9 feet deep at low water up to Washington; extended in 1879 to clear a channel 60 feet wide, 3 feet deep at low water 22 miles farther to Greenville, and 20 inches deep at low water 26 miles farther to Tarboro; again extended in 1889 to clear the river to its natural dimensions 40 miles farther to Little Fall, 2 miles below Rocky Mount, by removal of war obstructions, snags, logs, stumps, and overhanging trees, at a total final cost estimated in 1891 at $137,200. The project was extended in 1894 to include maintenance between Washington and Tarboro.

To the close of the fiscal year ending June 30, 1897, $97,859.07 had been expended.

At that date the river between Fishing Creek and Washington was clear of snags and the project width and depth existed. Above Fishing Creek the river had been roughly snagged several years before. The channel below Washington had been cleared of troublesome stumps and snags. The minimum depth below Washington was 7.5 feet.

By the expenditures of the fiscal year ending June 30, 1898, the river has been snagged again from Washington to mouth of Fishing Creek. The project width and depth exists above Washington.

The commerce during 1897 amounted to 363,513¼ tons, a gain of 111,625¾ tons over that of last year.

No transportation lines were established during the year.

It is estimated that $3,000 will be required annually for maintenance of the improvement, including snagging.

July 1, 1897, balance unexpended	$5,140.93
June 30, 1898, amount expended during fiscal year	3,854.20
July 1, 1898, balance unexpended	1,286.73
Amount (estimated) required for completion of existing project	38,500.00
Amount (estimated) required for maintenance annually	3,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, including maintenance	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix M 3.)

4. Contentnia Creek, North Carolina.—When the United States began to improve this creek, in 1881, it was badly choked with fallen timber, snags, logs, stumps, sand bars, and dense overhanging growth.

The project of 1881, amended in 1894 to include maintenance below Snow Hill, is, by clearing it of these obstructions, to obtain from its confluence with the Neuse to Stantonsburg, 63 miles, a depth of not less than 3 feet during the higher stages of about nine months' duration annually at a cost estimated in 1888 at $77,500.

To June 30, 1897, there had been expended $66,869.50.

At that date the creek between Snow Hill and its mouth was fairly clear of snags, and the project depth existed between these points.

By the expenditures of the year ending June 30, 1898, the creek has again been cleared of snags from Snow Hill to its mouth.

The commerce during 1897 amounted to 2,800 tons, a loss since last year of 14,004¾ tons, including timber. Extreme low water during nearly the entire year curtailed the commerce.

No transportation lines were established during the year.

It is estimated that $2,000 will be required annually for maintenance of the improvement, including snagging.

July 1, 1897, balance unexpended	$2,130.50
June 30, 1898, amount expended during fiscal year	955.57
July 1, 1898, balance unexpended	1,174.93
July 1, 1898, outstanding liabilities	336.90
July 1, 1898, balance available	838.03
Amount (estimated) required for completion of existing project	8,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix M 4.)

5. Trent River, North Carolina.—When the United States began to improve this river in 1879 there was a channel 6 feet deep, comparatively free from obstructions, from Newbern, 18 miles, to Polloksville. Above Polloksville it was obstructed by bars of sand and rock, and especially by great numbers of snags in the 11 miles from Lower Quaker Bridge up to Trenton. One steamer ran regularly to Polloksville, and one occasionally 9 miles farther, to Lower Quaker Bridge, above which point navigation was confined to flatboats and rafts.

The project of 1879, extended in 1886 to include an 8-foot channel through Foys Flats above Newbern, was to secure a channel 3 feet deep at low summer stage from Polloksville to Trenton, by removing all obstructions and dredging a cut 50 feet wide through the shoals at a cost estimated in 1887 at $59,000.

In 1889 the project was extended to remove obstructions to permit navigation by small steamboats 33 miles above Trenton, and by pole boats 6½ miles farther, to Upper Quaker Bridge, at an additional cost of $13,000.

In 1892 the project was extended to include maintenance below Trenton, and in 1896 so as to provide only for maintenance of a channel 30 feet wide and 3 feet deep to Trenton.

To the close of the fiscal year ending June 30, 1897, $64,425.23 had been expended.

At that date a channel 30 feet wide and 3 feet deep at low water had been completed to Trenton and was clear of snags.

By the expenditure of the fiscal year ending June 30, 1898, the river has again been cleared of snags from Newbern to Trenton.

The dredged cuts just below Trenton have shoaled, reducing the available depth to about 18 inches at low water.

The commerce during 1897 amounted to 142,788¾ tons, a gain of 688 tons over last year.

No transportation lines were established during the year.

It is estimated that $2,500 annually will be required for maintenance of the improvement.

July 1, 1897, balance unexpended	$2,074.77
June 30, 1898, amount expended during fiscal year	787.34
July 1, 1898, balance unexpended	1,287.43
July 1, 1898, outstanding liabilities	4.80
July 1, 1898, balance available	1,282.63
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	2,500.00

(See Appendix M 5.)

6. *Neuse River, North Carolina.*—When the United States commenced the improvement, in 1878, the minimum channel depth in this river for nine months annually was 9 feet to Newbern, 4 feet to Kinston, 3 feet to Goldsboro, and 2 feet to Smithfield. The river was badly obstructed by war and other obstructions.

The approved project of 1871, as modified in 1878, 1879, 1880, 1883, and 1888, is to assure an 8-foot navigation up to Newbern during the entire year, 4 feet to Kinston, and during nine months of the year 3 feet to Smithfield, the work to be done by removing war obstructions, dredging, jettying, and snagging, at a total cost estimated at $374,000.

In 1896 the project was extended to include maintenance.

Up to the close of the fiscal year ending June 30, 1897, $294,219.65 had been expended upon this improvement.

At that date the ruling depth between Newbern and the mouth of Contentnia Creek, 18 miles below Kinston, was 4 feet at low water, and from there to Kinston 2 feet. Many of the old jetties were in need of repairs; some had entirely washed away. The river from the Wilmington and Weldon Railroad Bridge, near Goldsboro, to Newbern was tolerably clear of snags.

As a result of the work of the fiscal year ending June 30, 1898, the river has again been snagged from 35-mile post to Newbern. Two new jetties below mouth of Contentnia Creek were completed, two new ones above the mouth were built, and several repaired. The ruling depth between Contentnia Creek and Kinston is 2 feet, and between Newbern and Contentnia 4 feet.

The commerce during 1897 amounted to 380,749¼ tons, a gain of 83,657 tons over that of last year.

No transportation lines were established during the year.

It is estimated that $5,000 will be required annually for maintenance of the improvement, including snagging.

July 1, 1897, balance unexpended	$2,280.35
June 30, 1898, amount expended during fiscal year	1,367.23
July 1, 1898, balance unexpended	913.12
July 1, 1898, outstanding liabilities	2.40
July 1, 1898, balance available	910.72
Amount (estimated) required for completion of existing project	77,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	10,000.00

(See Appendix M 6.)

7. *Inland waterway between Newbern and Beaufort, N. C.* (via Neuse and Clubfoot rivers, Clubfoot and Harlowe Canal, owned by the Albemarle and Chesapeake Canal Company, and Harlowe and Newport rivers to Beaufort Harbor).—When the United States began this improvement, in 1885, that part of the waterway, 18 miles in length, across the peninsula between the Neuse River and Bogue and Core sounds, embracing 15.5 miles of natural channel, connected at the summit by the Clubfoot and Harlowe Canal, was navigated by boats 15 feet wide, with a draft of 1 foot at low water and about 2½ feet at high water.

The project of 1884 is to obtain a channel 30 feet wide at bottom and 5 feet deep at mean low water across the peninsula by dredging in Clubfoot, Newport, and Harlowe rivers, and by improvement of the canal, at a cost estimated in 1886 at $92,000.

To June 30, 1897, $27,914.39 had been spent upon this work.

At that date the cuts dredged by the United States in Harlowe Creek had remained as dredged, but the cut dredged at the mouth of the creek had deteriorated until scarcely a trace of it remained. The least available channel width in Clubfoot Creek and in Harlowe Creek was 25 feet. Some logs were to be encountered in these creeks. Many sunken logs were in the canal. It had narrowed and shoaled, and had a depth of 1.5 feet at ordinary low water and 3 feet at ordinary high water.

By the expenditure of the fiscal year ending June 30, 1898, the logs and snags have been removed from Clubfoot and Harlowe creeks. Otherwise the condition remains the same as at the beginning of the year.

Further work, except maintenance, by snagging, of a depth equal to that in the canal, has been postponed to await the cession or sale of the canal to the United States. (See Annual Report, Chief of Engineers for 1891, p. 161.)

The commerce on this waterway during 1897 amounted to 38,897½ tons, a gain of 9,160½ tons over last year.

No transportation lines were established during the year.

July 1, 1897, balance unexpended	$7,085.61
June 30, 1898, amount expended during fiscal year	300.00
July 1, 1898, balance unexpended	6,785.61

(See Appendix M 7.)

8. *Harbor at Beaufort, N. C.*—When this improvement by the United States (begun in 1836) was resumed in 1881 the erosion of Fort Macon and Shackleford points and widening of the entrance between them caused serious shoaling of the channel inside the bar, across which there was a mid-channel depth of not less than 15.3 feet at low water. Within the harbor from the Bulkhead Channel a draft of only 2 feet at low water could be carried to the wharves at Beaufort.

The project of 1881 was to stop the erosion at Fort Macon and Shackleford points by jetties, to dredge a channel 200 feet wide and 9 feet deep at low water from the Bulkhead Channel 1,950 feet to the wharves at Beaufort, and to dredge a channel 100 feet wide and 6 feet deep at mean low water from the 6-foot contour leading to North River, a distance of 12,670 feet.

In 1887 the project was modified by postponing for the present the dredging of the cut through the Old Town Channel to North River, and by reducing to the width of 100 feet and depth of 5 feet the channel to be dredged from the Bulkhead Channel to Beaufort; and in 1890 the project was again modified by increasing the latter dredging to the

depth of 7 feet. The cost of executing the project was estimated in 1887 at $163,000.

In 1896 the project was amended so as to include only the building and repair of jetties and sand fences at Fort Macon and Shackleford points to stop erosion.

Up to the close of the fiscal year ending June 30, 1897, $149,365.46 had been expended on this improvement.

At that date the channel leading to the town of Beaufort was in good condition; the channel across the Bulkhead dredged in 1895 had shoaled to about 4 feet at low water. The depth on the main bar was 10.5 feet at low water.

The work during the fiscal year ending June 30, 1898, has been confined to the maintenance of the sand fences at the harbor entrance, with the result of some improvement in raising the beaches.

The channels are in the same condition as at the end of the last year.

The commerce during 1897 amounted to 34,930½ tons, a loss over last year of 3,876½ tons.

No transportation lines were established during the year.

July 1, 1897, balance unexpended	$5,634.54
June 30, 1898, amount expended during fiscal year	1,494.85
July 1, 1898, balance unexpended	4,139.69
July 1, 1898, outstanding liabilities	85.80
July 1, 1898, balance available	4,053.89

(See Appendix M 8.)

9. Inland waterway between Beaufort Harbor and New River, North Carolina.—In 1886, when the first appropriation for this improvement was made, there were in the 28 miles in Bogue Sound from Beaufort to Swansboro six shoals, aggregating about 4 miles in length, over which not more than 18 inches could be carried at low water. Elsewhere the channel was not less than 3 feet deep. From Swansboro 22 miles to New River the route followed intricate tidal channels, varying from 1,000 to 12 feet in width and 10 feet to 6 inches in depth at ordinary low water.

The project adopted in 1885 embraced only that part of the route from Beaufort to Swansboro, and is to obtain a channel of the minimum depth of 3 feet and width of 100 feet by dredging through all the shoals, at an estimated cost of $50,000.

In 1896 the project was modified to read, "to obtain a channel 60 feet wide and 3 feet deep at mean low water through Bogue Sound."

To June 30, 1897, $42,500 had been expended upon this work.

At that date a channel of the variable widths 40, 60, and 100 feet, and not less than 3 feet deep at low water, had been obtained by dredging through 6 shoals, aggregating 4.8 miles in length.

During the fiscal year ending June 30, 1898, there has been no work done or expenditures made.

The commerce during 1897 amounted to 19,193¾ tons, a gain of 1,171¾ tons since last year.

No transportation lines were established during the year.

July 1, 1897, balance unexpended	$1,000.00
July 1, 1898, balance unexpended	1,000.00
Amount (estimated) required for completion of existing project	6,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	6,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix M 9.)

10. New River, North Carolina.—In 1886, when the United States began this improvement, there was around Cedar Bush Marsh, 1½ miles above the mouth, a circuitous channel in which the depth was less than 4 feet on two shoals, and around Wrights Island, 700 yards above the bar, a circuitous channel, but not less than 5 feet deep at mean low water. Except around Cedar Bush Marsh 4 feet could be carried from the ocean, 23 miles, to Jacksonville.

The original project, adopted in 1882, was to straighten, widen to 150 feet, and deepen by dredging to 5 feet at mean low water the channel around the marsh, at an estimated cost of $40,000.

The project of 1885 was to dredge a straight channel 4 feet deep at mean low water, 150 feet wide, and 5,710 feet long, through Cedar Bush Marsh; also to dredge a channel 4 feet deep, 150 feet wide (changed in 1892 to 100 feet), and 1,200 feet long, through Wrights Island.

June 18, 1894, the project was again modified to improve by a training wall and by dredging the channel around Cedar Bush Marsh, in place of the cut made through the marsh, which had to be abandoned in consequence of shoaling at its upper extremity.

To June 30, 1897, $29,500 had been expended on this improvement. At that date the project depth existed except at Cedar Bush Marsh shoal, where the available depth was 3 feet.

No field work has been done during the fiscal year ending June 30, 1898. An inspection of the work was made.

At the close of the year the channel has slightly deteriorated. The training wall has been nearly destroyed by the teredo, and the depth of water on the shoal is slightly less than 3 feet.

The commerce on this stream during 1897 amounted to 2,107 tons, a loss of 5,106 tons since last year.

No transportation lines were established during the year.

July 1, 1897, balance unexpended	$3,500.00
June 30, 1898, amount expended during fiscal year	100.00
July 1, 1898, balance unexpended	3,400.00

(See Appendix M 10.)

11. Black River, North Carolina.—When the United States began to improve this river, in 1887, the channel from the mouth 24 miles to Point Caswell was fairly cleared to a depth not less than 4 feet at low summer stages, and was roughly cleared 62 miles farther to Lisbon, with a least channel depth of 2½ feet at low stage in the 10 miles from Point Caswell to Haws Narrows; thence 52 miles to Lisbon the depth at low summer stage was 18 inches to 3 feet on the shoals and 10 to 12 feet in the pools.

The project of 1885, modified in 1892 and 1893, was to apply at least $13,000 to removing logs, snags, and overhanging trees from the bed and banks and rounding off a few of the sharpest bends in the river from its confluence with the Cape Fear up 64 miles to Clear Run.

This project was completed September 20, 1895.

The project of 1894 was the maintenance of the channel up to Clear Run clear of logs, snags, and overhanging trees.

The project of 1896 is the continuation of that of 1894.

To the close of the fiscal year ending June 30, 1897, $15,472.51 had been expended.

At that date the river had been cleared of snags and overhanging trees from its confluence with the Cape Fear to Clear Run (64 miles).

Navigation was obstructed for several months in each year by shoals, and the river was obstructed by snags and overhanging trees, particularly below the forty-seventh milepost.

During the fiscal year ending June 30, 1898, owing to the limited amount of funds available, no work could be attempted.

The commerce during 1897 amounted to 31,144 tons, a loss of 37,889¼ tons since last year.

No transportation lines were established during the year.

It is estimated that $2,000 will be required for maintenance of the improvement during the fiscal year ending June 30, 1900.

July 1, 1897, balance unexpended	$770.83
June 30, 1898, amount expended during fiscal year	1.50
July 1, 1898, balance unexpended	769.33
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	2,000.00

(See Appendix M 11.)

12. North East (Cape Fear) River, North Carolina.—In 1890, when the United States began to improve this river, a draft of at least 6 feet could be carried up 48 miles to Bannerman's bridge at lowest stage. From Bannerman's bridge, 55 miles up to Kornegay's bridge, the river is so shallow that its navigation is dependent upon freshet stages. Above Bannerman's bridge it was badly obstructed by snags and overhanging trees.

The project of 1889 is to clear the channel to its natural depth and to a good width for small light-draft steamers up to Hallsville, and for pole boats up to Kornegay's bridge, at an estimated cost of $30,000.

To the close of the fiscal year ending June 30, 1897, $14,675.22 had been expended.

At that date snags and other obstructions had been removed between the 56th and the 98½ mileposts, and over a space of three miles immediately above Wilmington. In consequence of this work a small steamboat had commenced to make semiweekly trips from Wilmington to Croom's bridge and to Hallsville weekly, when the stage of water permitted.

During the fiscal year ending June 30, 1896, owing to the limited amount of funds available, no work was done.

The commerce during 1897 amounted to 63,398 tons, a loss of 21,765½ tons since last year.

No transportation lines were established during the year.

It is estimated that $2,000 will be required for maintenance of the improvement during the fiscal year ending June 30, 1900.

July 1, 1897, balance unexpended	$568.11
June 30, 1898, amount expended during fiscal year	1.30
July 1, 1898, balance unexpended	566.81
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	2,000.00

(See Appendix M 12.)

13. Cape Fear River above Wilmington, N. C.—In 1882, when the United States began to improve this river, a draft of 4 feet could be carried at lowest stages 47 miles above Wilmington to Kellys Cove; thence 68 miles to Fayetteville there were many shoals, on some of which the depth was not more than 12 to 14 inches during the low stage; from Indian Wells Landing, 37 miles above Wilmington, 78 miles to Fayetteville, the river was badly obstructed by snags, logs, and overhanging trees.

The project of 1881, as matured in 1885 and 1886, is to obtain at all times of the year a depth of 4 feet from Wilmington 73 miles to Elizabethtown, and of 3 feet thence 42 miles to Fayetteville, by removing snags and rocks from the bed and overhanging trees from the banks, by contracting the channel by jetties on the shoals, and by a little dredging at a bar of clay, at a total cost estimated in 1886 at $472,000.

To the close of the fiscal year ending June 30, 1897, $133,232.87 had been expended.

At that date the river was obstructed by many sunken logs and snags from the head of navigation at Fayetteville to the head of tide water at Kellys Cove.

During the year the river was snagged from Kellys Cove to Fayetteville.

The commerce during 1897 amounted to 91,841 tons, a loss since last year of 7,516½ tons.

No transportation lines were established during the year.

It is estimated that $3,000 will be required annually for maintenance of the improvement, including snagging.

July 1, 1897, balance unexpended	$4,431.46
June 30, 1898, amount expended during fiscal year	3,032.64
July 1, 1898, balance unexpended	1,398.82
July 1, 1898, outstanding liabilities	33.31
July 1, 1898, balance available	1,365.51
Amount (estimated) required for completion of existing project	137,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix M 13.)

14. Cape Fear River at and below Wilmington, N. C.—The United States began to improve the river between the bar and Wilmington in 1829 and the channel on the bar in 1853. In 1829 the river was so obstructed that vessels drawing more than 10 feet were obliged to anchor 14 miles below Wilmington and discharge a part of their cargoes into lighters. In 1853 at low water on the bar the least mid-channel depth was 7 feet in the western channel, 7½ feet in the eastern channel, and 8 feet at New Inlet, 7 miles above the mouth.

The original project of 1827 was to deepen the channel through the shoals in the 8 miles next below Wilmington by contracting it by jetties and by diverting into it water from Brunswick River and from Fishing and Rodmans creeks.

The project of 1853 was to straighten and deepen the channel on the bar by building jetties and a wing dam, by dredging, by diverting water through it from New Inlet, by building a jetty at Federal Point, and by closing two small breaches in Zekes Island.

The project of 1870 was to deepen the bar channel by closing the

breaches between Smiths and Zekes islands, with the ultimate closure of New Inlet in view.

The project of 1873 was to deepen the channel through the bar, added to that of 1870, to dredge in the Baldhead (eastern) Channel, to extend across Zekes Island and beyond it into the river the dam then being built to close the breaches between Smiths and Zekes islands, and to close New Inlet, commencing with the building of a jetty from Federal Point.

The project of 1874 was "to get 12 feet at low water as high as the city of Wilmington" by dredging a channel 100 feet wide through Horseshoe Shoal below New Inlet and through three other shoals near Wilmington.

The project of 1881 was to dredge a channel 2¾ miles in length through Horseshoe Shoal and through eight other shoals above it 270 feet wide and 16 feet deep at mean low water from deep water at Smithville (Southport) to Wilmington.

February 28, 1889, pursuant to a requirement of the river and harbor act of August 11, 1888, the cost of obtaining a channel 20 feet deep at mean low water from Wilmington to the ocean was reported to be $1,800,000. In the Annual Report for 1889 it was reported that an additional appropriation of $25,000 would be required to complete the project of 1881 and obtain a channel 16 feet deep from Wilmington to the ocean. By the river and harbor act of September 19, 1890, Congress appropriated $170,000 for improving the Cape Fear River at and below Wilmington, and dredging to the depth of 20 feet commenced at Wilmington January 19, 1891, and ceased at Brunswick River Shoal, 4½ miles below Wilmington, September 7, 1892.

Since September 7, 1892, work has been in progress to obtain a channel through the shoals between Wilmington and the bar, and on the latter 18 feet deep at mean low water.

The project of 1896 is to obtain a depth at mean low water of 20 feet and a channel width of 150 feet (of the 270 feet projected in 1889) from Wilmington to the ocean.

Expenditures to June 30, 1897, were $2,697,000.99.

At that date a channel 20 feet deep existed over the bar and a channel 18 feet deep had been dredged through the shoals in the river to Wilmington. The following shoals had been dug to 20 feet depth: Wilmington for a width of 270 feet, Alligator Creek for a width of 148 feet, Brunswick River for a width of 74 feet, and Lilliput (lower reach) for a width of from 37 to 74 feet.

The breach around the shore end of New Inlet Dam at Federal Point has been closed.

The results derived from the expenditures during the year have been that the 20-foot channel at Lilliput Shoal has been increased in width to 148 feet on the lower reach and 74 to 111 feet on the upper reach, a 20-foot channel has been dredged through Old Brunswick Cove Shoal 148 feet wide, and at Midnight Shoal a 20-foot channel has been dredged through the upper reach 74 feet wide and through the lower reach 37 feet wide.

The commerce during 1897 amounted to 595,426 tons, a loss of 77,782 tons since last year.

No transportation lines were established during the year.

It is estimated that $25,000 will be required annually for maintenance of the improvement where the projected depth and width have been obtained.

July 1, 1897, balance unexpended		$173,114.01
November 15, 1897, proceeds of sale, interappropriations	$775.70	
November 24, 1897, proceeds of sale, interappropriations	75.66	
December 21, 1897, proceeds of sale, interappropriations	58.20	
		909.56
		174,023.57
June 30, 1898, amount expended during fiscal year		71,934.68
July 1, 1898, balance unexpended		102,088.89
July 1, 1898, outstanding liabilities		2,289.28
July 1, 1898, balance available		99,799.61

Amount (estimated) required for completion of existing project	1,035,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	150,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix M 14.)

IMPROVEMENT OF WACCAMAW RIVER, NORTH CAROLINA AND SOUTH CAROLINA, AND OF CERTAIN RIVERS AND HARBORS IN SOUTH CAROLINA.

This district was in the charge of Maj. Frederic V. Abbot, Corps of Engineers, to September 15, 1897, having under his immediate orders Lieut. Edwin R. Stuart, Corps of Engineers; in the temporary charge of Lieutenant Stuart from September 15 to October 9, 1897, and in the charge of Maj. E. H. Ruffner, Corps of Engineers, since that date, these officers having under their immediate orders Lieut. Harley B. Ferguson, Corps of Engineers, from September 30, 1897, to April 11, 1898, Lieutenant Stuart from October 9 to November 10, 1897, Lieut. Charles Keller, Corps of Engineers, since April 11, 1898, and Lieut. Edward H. Schulz, Corps of Engineers, since May 20, 1898. Division Engineer, Brig. Gen. Peter C. Hains, U. S. Volunteers, colonel, Corps of Engineers.

1. Waccamaw River, North Carolina and South Carolina.—In 1880 this stream was navigable for 12-foot boats at all stages of water from Georgetown, 23 miles, to Bull Creek, and at high water 4 miles farther, to Bucks Lower Mills; thence for 7-foot-draft boats, at high water, 22 miles farther, to Conway; thence it possessed an obstructed channel for 3-foot-draft boats, at ordinary winter water, 68 miles, to Reeves Ferry; thence an obstructed channel, with 3 feet at high water, for 30 miles, to Lake Waccamaw.

The project of improvement provides for a channel 12 feet deep at all stages of water with 80 feet bottom width from the mouth of the river to Conway, thence a cleared channel to Lake Waccamaw, at an estimated cost of $138,400.

The original estimated cost was $29,370, which was revised in 1885 and increased in the Annual Report of that year to the present figure, $138,400. In Annual Report for 1886, page 170, maintenance is estimated at $4,000 per year after completion of improvement.

The total expenditure to June 30, 1897, was $97,035.87. At that date the river was safely navigable for steamers over the whole improved portion.

During the past year the river was snagged at intervals, 2,031 obstructions having been removed. This makes the aggregate number of obstructions removed since June 30, 1884, 32,429. The total expenditures for the corresponding period have been $72,252.51. During the past fiscal year $2,281.82 has been spent and the former improved portion of the river has been kept free of snags.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1887		$2,129,231.75	1894	99,298	$2,120,864.00
1889		2,308,915.00	1895	128,466	2,063,697.00
1890	67,195	2,317,368.50	1896	203,388	2,314,175.00
1891	76,245	2,231,112.00	1897	241,300	2,406,390.00
1892	83,103	2,178,369.00	1898	258,191	2,666,280.00
1893	70,976	2,095,548.00			

July 1, 1897, balance unexpended	$2,864.13
June 30, 1898, amount expended during fiscal year	2,281.82
July 1, 1898, balance unexpended	582.31
Amount (estimated) required for completion of existing project	38,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	3,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix N 1.)

2. *Little Pedee River, South Carolina.*—The river in its original condition was much obstructed by snags and overhanging trees and by ten bridges without draws. In places it was divided into several branches, in none of which was there a good channel.

Under the plan of improvement it is proposed to snag the river and close unnecessary branches, providing for steamboat navigation up to the mouth of Lumber River and pole-boat navigation thence to Little Rock, at an estimated cost of $50,000.

The total expenditures to June 30, 1897, were $20,514.19. At that date the river had been quite well snagged from the mouth, 65 miles to the mouth of Lumber River, and roughly cleared for pole boats and rafts 48 miles farther, to Little Rock. A plant had been built and 16,302 obstructions removed.

During the past year $1,171.85 has been spent for office expenses and care of plant. No obstructions have been removed. From the beginning 20,869 obstructions have been removed. Some dredging will be needed to develop the full value of this stream.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	4,614	$52,760	1895	12,438	$117,470
1892	7,115	92,964	1896	17,050	198,500
1893	6,153	101,535	1897	13,162	100,400
1894	8,375	114,600	1898	11,900	105,750

July 1, 1897, balance unexpended	$1,485.81
June 30, 1898, amount expended during fiscal year	1,171.85
July 1, 1898, balance unexpended	313.96
Amount (estimated) required for completion of existing project	28,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	3,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix N 2.)

3. *Great Pedee River, South Carolina.*—The river in its original condition was dangerously obstructed by logs everywhere. Boats drawing 9 feet of water were able to reach Smith Mills, 52 miles above the

mouth. Those drawing 3½ feet could get 54 miles farther up at low water to Little Bluff, or at high water to Cheraw, 172 miles from the mouth.

The project of improvement provides for a thoroughly cleared 9-foot navigation to Smith Mills and a 3½-foot navigation to Cheraw at all stages of water, at an estimated cost of $117,000.

The original project of 1880 contained no estimate of cost. From 1880 to 1886, inclusive, $47,000 was appropriated. In the Annual Report for 1886, page 170, it was estimated that $70,000 in addition to this $47,000 would complete the improvement and that $5,000 a year would be required for maintenance.

The total expenditure to June 30, 1897, was $99,504.85.

At that date, the river as far up as the Wilmington, Columbia and Augusta Railroad Bridge had been thoroughly snagged and was in good condition for steamers to run by night as well as by day. This bridge is 103 miles above the mouth. The remaining 69 miles to Cheraw, which is the head of the projected improvement, was still in bad condition, although steamers ran as far as Cheraw, except when the river was low. A snag boat had been built especially for use on this upper river.

During the year $3,890.48 has been expended and 4,059 obstructions have been removed. Since June 30, 1884, 31,996 obstructions have been removed. Some dredging will be needed to develop the full value of the stream.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	62,344	$1,367,330	1895	106,115	$893,430
1892	92,471	1,401,038	1896	229,964	1,325,250
1893	94,661	1,166,874	1897	114,177	1,167,914
1894	91,025	1,169,070	1898	75,280	1,228,885

July 1, 1897, balance unexpended	$7,995.15
June 30, 1898, amount expended during fiscal year	3,890.48
July 1, 1898, balance unexpended	4,104.67
July 1, 1898, outstanding liabilities	510.00
July 1, 1898, balance available	3,594.67
Amount (estimated) required for completion of existing project	9,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	9,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix N 3.)

4. Winyah Bay, South Carolina.—This large bay is connected with the ocean by a passage between the shores of North and South islands 2½ miles long, 1 mile wide at the bay, three-fourths of a mile at its gorge, and 1¼ miles wide at the ocean or southeasterly end of North Island. Through the passage, which trends north-northwest and south-southeast, there is a bold channel 36 feet deep at the bay, retaining a depth of not less than 20 feet until about 3,000 feet southerly from the end of North Island and of not less than 15 feet to a point about 1 mile south of the island, where the channel divides into two. One of these two channels, known as the main ship channel, continues 3¼ miles farther, through extensive shoals, to the 18-foot contour in the ocean. This channel is south-southeast and in alignment with the bold

channel through the straits. The other, known as Bottle Channel, after flowing about 2,500 feet southeasterly, 1,500 feet easterly, and about 3,000 feet northeasterly, before the improvement commenced reached the 18-foot contour in the ocean at a distance of about 1½ miles in a direction from the point of separation from the main ship channel almost at right angles with the direction of that channel and of the channel through the passage. At mean low water the depth on the crest of the bar was variable in both channels and about 7 to 9 feet in the main channel and 6 to 8 feet in Bottle Channel. The mean range of tide is 3½ feet.

The original project provides for two jetties springing respectively from North and South islands and converging toward the bar. They are to be constructed of mattress foundation, loaded with a stone superstructure, composed of large riprap. The height of crest of each jetty is to be 6 feet above mean low water. The originally projected length of the north jetty was 10,700 feet, that of the south jetty 17,500 feet. Since the date at which the project was approved the shore lines and curves on the bar have changed so materially as to make it necessary to shift the positions of the jetties somewhat; as the project now stands the authority for such changes, without change in estimate, is given in the letter of the Chief of Engineers, dated April 2, 1897. The depth to be secured is 15 feet at mean low water. The total expenditure to June 30, 1897, was $431,888.14.

To June 30, 1891, the north jetty had been advanced only to about low-water line; June 30, 1892, the end of the jetty was 2,090 feet beyond the low-water line, with its crest 18 inches above mean low water; July 22, 1893, on suspension of work, the jetty had been built to a height of 18 inches above mean low water for a distance of 2,200 feet from shore, and the mattresses had been extended 1,464 feet farther, in which distance the height gradually diminished from 18 inches above mean low water to the thickness, about 2 feet, of the ballast on the mattresses at their extremities.

On June 30, 1895, the jetty had been built to a height of 18 inches above mean low water for a distance of 4,700 feet from the shore end, and the extremity of the mattresses was 6,655 feet from the same point. The low-water line, which was, in 1890, 570 feet from the initial point of the jetty, was on June 30, 1895, 1,070 feet from that point.

During the fiscal year ending June 30, 1896, the work was continued on north jetty, extending that part of it which is 18 inches above low water to a point 5,200 feet, at low water to 5,500 feet, and at a level just above the bottom to 6,655 feet from the shore end. About 5,000 tons of large stone and 3,000 tons of small stone were used. It cost $17,000 in round numbers.

The aggregate material in the north jetty so far is as follows: Mattress, 60,401 square yards; stone, 107,735 tons; sheet piling, 194,976 feet B. M.; oyster shells, 601 cubic yards.

The spur jetties on South Island beach were completed. On the mud dike 21,169 cubic yards of mud was deposited, making its total prism 113,923 cubic yards; 16,404 square yards of sodding was also done.

Specifications for completing the improvement under continuing contracts were prepared and bids opened on March 12, 1897, for completing the mud dike, for constructing jetties, and for constructing a pump dredge.

During the past year the north end of the mud dike was extended, using 40,313.35 cubic yards of mud and 48,776.6 square yards of sod-

ding. A muck ditch 2,575 feet long was dug. Work under the contract for constructing the jetties did not begin until March 1, 1898, after which time 1,993 linear feet of jetty was partially built. The material used was 10,463.33 square yards of mattress, 8,233.43 tons of ballast, and 1,899.6 tons of large stone. The steam pump dredge for this place was nearly completed at the end of the year.

The Bottle Channel, which had begun to deepen in 1896, had maintained its depth of 9 feet in May, 1897, and was 625 feet wide. In 1898 an increase of 1 foot is shown in depth and 125 feet in width of channel.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	261,370	$8,071,600	1896	171,059	$6,228,350
1892	271,986		1897	149,374	5,817,950
1893	268,640		1898	125,003	5,587,880
1894	293,822				

July 1, 1897, balance unexpended		$366,861.86
Amount appropriated by sundry civil act approved July 1, 1898		450,000.00
		816,861.86
June 30, 1898, amount expended during fiscal year		45,592.01
July 1, 1898, balance unexpended		771,269.85
July 1, 1898, outstanding liabilities	$11,800.00	
July 1, 1898, amount covered by uncompleted contracts	1,297,599.59	
		1,309,399.59
Amount that can be profitably expended in fiscal year ending June 30, 1900. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		400,000.00

(See Appendix N 4.)

5. *Santee River, South Carolina.*—This river in its original condition was considerably obstructed at all stages of water by sunken logs and snags. Its bar entrance was narrow, crooked, and shifting, with only about 4 feet of water at low tide. Four steamers and a few vessels were then running upon portions of the river.

The project of 1880 proposed to provide the river with a good outlet through Mosquito Creek to Winyah Bay by deepening and straightening this creek to 50 feet width and 7 feet depth; to secure 7-foot navigation in the river from its mouth 120 miles to Wright Bluff, and thence 5-foot navigation 23 miles farther to its head in the Congaree and Wateree rivers.

The estimated cost was $104,427.40. At the same time the estimated cost of cutting a canal from Estherville plantation to Minim Creek, in lieu of the Mosquito Creek Canal, was $158,000. In 1887 the estimate was increased to $346,500.

The revised project of 1889 provides for leaving the Mosquito Creek Canal, which has been completed 30 feet wide and 3 feet deep, for a timber route, cutting a new canal between Estherville and Minim Creek large enough for river steamers, and snagging the entire river, at an estimated cost of $350,000.

The project of 1889 was submitted to Congress in the Annual Report for that year, page 1184.

Total expenditures to June 30, 1897, was $222,762.42.

At that date the first cut of the Estherville-Minim Creek Canal was entirely through to the Santee River. The Mosquito Creek Canal was in fair condition, and was much used as a timber route. During the past year $16,784.72 has been spent, and 167,305 cubic yards of material and 648 stumps have been removed, widening and deepening portions of the channel. The river itself is safely navigable at extreme low water.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	100,255	$2,743,000	1895	117,690	$2,224,800
1892	110,523	2,775,800	1896	134,135	2,204,600
1893	124,182	2,679,600	1897	134,206	2,159,940
1894	115,428	2,375,000	1898	112,205	2,203,800

July 1, 1897, balance unexpended	$24,987.58
June 30, 1898, amount expended during fiscal year	16,784.72
July 1, 1898, balance unexpended	8,202.86
July 1, 1898, outstanding liabilities	1,200.00
July 1, 1898, balance available	7,002.86

Amount (estimated) required for completion of existing project	103,450.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix N 5.)

6. *Wateree River, South Carolina.*—In 1882 this stream, in its original condition, had a low-water depth of from 3 to 4 feet from its mouth, 67 miles to Camden. The lower 14 miles was completely blocked at all stages of water by logs, snags, etc., and at moderate stages by the bridges of the South Carolina and the Wilmington, Columbia and Augusta railroads, then without drawspans; thence to Camden navigation was possible, but dangerous, except during high water. Its commerce was practically nothing.

The project of improvement provides for safe and unobstructed 4-foot navigation for steamers from Camden to the mouth, at an estimated cost of $60,000.

Congress has made appropriations for maintenance since the project was completed.

The total expenditure to June 30, 1897, was $67,206.59. At that date the river had been quite thoroughly snagged between its mouth and Camden, the projected head of navigation. A snagging steamer had been built, and 19,801 obstructions removed. A line of steamers was running irregularly on the river.

During the past year $2,455.02 has been spent and 3,657 obstructions have been removed. Since June 30, 1884, 23,458 obstructions have been removed.

The river is deep and requires no dredging at any point, but it will require snagging annually, as its banks cave. The channel has been satisfactorily maintained throughout the year.

It is estimated that $6,000 will be required for maintenance of the improvement during the fiscal year ending June 30, 1900.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	1,005	$51,210	1895	21,697	$127,565
1892	2,244	86,040	1896	35,002	233,525
1893	6,242	117,729	1897	43,770	202,800
1894	18,075	94,334	1898	83,568	274,050

July 1, 1897, balance unexpended	$2,793.41
July 30, 1898, amount expended during fiscal year	2,455.02
July 1, 1898, balance unexpended	338.39
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	6,000.00

(See Appendix N 6.)

7. *Congaree River, South Carolina.*—In 1886 this stream, in its original condition, had a low-water depth of 3 to 4 feet from its mouth to the railroad bridge at Columbia; thence 1 foot low-water depth 2 miles farther to its head. Navigation of the lower 47 miles was blocked at all stages of water by the South Carolina Railroad Bridge, and by sunken logs, snags, and overhanging trees. The navigation of the remaining 2 miles was prevented by swift currents and numerous rock ledges and bowlders. Its commerce was nothing.

The project of improvement proposes to secure a thoroughly cleared 4-foot navigation over the lower 47 miles at all stages of water, and a cleared channel, 100 feet wide, through the shoals above, at an estimated cost of $54,500.

Pursuant to House resolution dated December 15, 1893, a project and estimate was submitted and printed as House Ex. Doc. No. 66 of that session, giving the cost of extending steamboat navigation from Granby to Gervais Street Bridge, Columbia. This document and a letter concerning it is reprinted on pages 1182–1189, Annual Report for 1896.

The total expenditure to June 30, 1897, was $29,321.93.

At that date the river had been thoroughly snagged from the mouth to Granby, 2 miles below Columbia, but no attempt had been made to improve the rapids above Granby. A snagging steamer had been built and 7,316 obstructions had been removed. A line of steamers was running very irregularly on the river.

During the past year $1,351.59 has been spent and 1,233 obstructions removed. From the beginning of the improvement 8,549 obstructions have been removed.

Some dredging will be needed to develop the full value of this stream and give the projected depth. Up to this time the snagging has been more important, so that steamers might run safely whenever the river was not too low for them to pass over the sand bars.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	2,401	$47,840	1895	8,993	$45,700
1892	3,686	62,025	1896	18,307	178,900
1893	2,781	71,125	1897	40,857	110,100
1894	7,974	40,760	1898	81,362	201,700

July 1, 1897, balance unexpended	$1,678.07
June 30, 1898, amount expended during fiscal year	1,351.59
July 1, 1898, balance unexpended	326.48
Amount (estimated) required for completion of existing project	23,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix N 7.)

8. *Charleston Harbor, including Mount Pleasant and Sullivan Island shore, South Carolina.*—There were originally four channels across the bar, the deepest having about 12 feet depth at low water. Commerce was then using the Pumpkin Hill Channel, about 3 miles south of the present jetty channel. Where the present jetty channel is situated there was then the swash channel, with a best depth of 10½ feet of water, too crooked for safe use. The natural channels were shifting in position and variable in depth.

In 1878 it was proposed to establish and maintain, by means of two jetties and auxiliary dredging, a low-water channel of not less than 21 feet depth across the bar. The swash channel was selected for improvement. The estimated cost was $3,000,000.

In 1888 it became necessary to modify the height of the crest line of the jetties and to revise the estimate. This increase in the estimate was largely due to the fact that money had been appropriated so slowly that reasonable contract prices could not be obtained. The annual appropriation up to that time had been only 5½ per cent of the original estimate. In the revised project the jetties were increased in height and length, but no change was made in their position or distance apart. The revised estimates were $4,380,500 if the jetties were brought up to low-water level throughout, and $5,334,500 if brought up 3 feet higher.

The total expenditure to June 30, 1897, was $3,946,863.30.

At that time the jetties were completed. A safe channel 18 feet deep and with a central depth of 18½ feet at low water was available for commerce.

During the past year the dredge *Charleston* has continued work. A small amount of additional stone has been deposited to reinforce the inner end of the north jetty and to check erosion of the Sullivan Island beach in the vicinity.

There has been a gain of 1 foot in depth at the entrance. There remains only a distance of about 700 feet on which the full projected depth of 21 feet at low water has not been obtained on the lighted range. There is a channel 21 feet deep entirely through, but narrow and crooked.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1889	2,192,975	$76,073,600	1893	3,088,951	$78,803,790
1890	2,570,551	90,009,500	1894	2,798,520	75,474,250
1891	2,823,315	95,003,358	1895	3,019,898	70,247,003
1892	2,664,954	86,985,196	1896	3,317,497	79,325,016

July 1, 1897, balance unexpended		$180,636.70
June 30, 1898, amount expended during fiscal year		58,617.08
July 1, 1898, balance unexpended		122,019.62
July 1, 1898, outstanding liabilities	$815.00	
July 1, 1898, amount covered by uncompleted contracts	2,500.00	
		3,315.00
July 1, 1898, balance available		118,704.62

(See Appendix N 8.)

9. Wappoo Cut, South Carolina.—Wappoo Cut, in its original condition, was a narrow, crooked tidal stream with not over 2 feet depth in some places. It connects Ashley and Stono rivers.

The original project provided for strengthening, widening, and deepening, so that the finished channel should be 6 feet deep and 90 feet wide at low water. Jetties at the Ashley and Stono entrances and light bulkheads across three tidal tributaries were to be built. The estimated cost was $34,000.

This project was modified in 1889 to provide for a 60-foot width of channel, for a solid cut through the marsh, and for a wider and deeper cut through the Ashley River Bar, at a total cost of $88,000.

The total expenditure to June 30, 1897, was $60,129.47. At that time there was a good 5½-foot channel of sufficient width all the way through. During the past fiscal year the only work done consisted of placing some additional stone on the revetment of Elliott Cut.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	140,000	$1,976,000	1894	238,350	$1,683,000
1892	.....	1,997,500	1895	250,230	2,260,100
1893	142,800	1,865,500	1896	271,800	2,410,000

July 1, 1897, balance unexpended	$2,370.53
June 30, 1898, amount expended during fiscal year	1,086.00
July 1, 1898, balance unexpended	1,284.53
Amount (estimated) required for completion of existing project	25,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	2,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix N 9.)

10. Beaufort River, South Carolina.—There was originally a thoroughly good 7-foot channel between the town of Beaufort and Coosaw River, except at a point called Brickyard, near the Coosaw mouth. The least depth here was about 4 feet at low water, and the channel, when deep enough, was too narrow.

The plan of improvement proposed was to deepen and widen the channel by dredging to give a continuous, sufficiently wide, 7-foot channel at low water all the way through. The estimated cost was $25,000. A layer of rock having been encountered at a higher level than was found by the preliminary borings, the work could not be completed for the amount of the original estimate. On April 15, 1893, the estimate was increased to $40,000.

The total expenditure to June 30, 1897, was $30,428.36, securing a channel 7 feet deep all the way through, but it was much too narrow for convenient use at the point where the rock was encountered. During the past year no work was done. The channel is now about 100 feet wide at the narrowest point.

The result of the dredging has been of great advantage to commerce in the way of safety, but to derive the full value of the improvement elsewhere the cut in the rocky portion must be made wider.

Commercial statistics.

Year.	Total tons.	Value.	Year.	Total tons.	Value.
1891	202,235	$1,378,800	1894	193,985	$950,000
1892	250,000	1,505,000	1895	174,300	919,750
1893	215,000	1,181,000	1896	100,267	588,000

July 1, 1897, balance unexpended	$571.64
June 30, 1898, amount expended during fiscal year	3.35
July 1, 1898, balance unexpended	568.29

Amount (estimated) required for completion of existing project	9,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	1,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix N 10.)

IMPROVEMENT OF RIVERS AND HARBORS IN EASTERN GEORGIA AND OF INSIDE WATER ROUTE BETWEEN SAVANNAH, GA., AND FERNANDINA, FLA.

This district was in the charge of Capt. O. M. Carter, Corps of Engineers, to July 20, 1897, and of Capt. Cassius E. Gillette, Corps of Engineers, since that date, Captain Gillette having under his immediate orders Lieut. Henry S. Morgan, Corps of Engineers, since September 30, 1897, and Lieut. Charles S. Bromwell, Corps of Engineers, since April 13, 1898. Division Engineer, Brig. Gen. Peter C. Hains, U. S. Volunteers, colonel, Corps of Engineers.

1. Savannah Harbor, Georgia.—In 1873, prior to improvement, the channel was in places not more than 9 feet deep at mean low water, and the usual draft of vessels navigating the harbor at high water was 14½ feet.

The original plan of improvement is dated August 28, 1873, and was supplemented March 19, 1879; it contemplates the establishment of a channel from the city to the sea practicable at high tide for vessels drawing 22 feet of water, and its cost was estimated at $481,320. This project was replaced by an enlarged one (January 16, 1882, Annual Report of the Chief of Engineers for 1882, Appendix J 4) contemplating the same channel depth, the cost being estimated at $1,212,000, including former appropriations.

In 1887, in obedience to an act of Congress approved August 5, 1886, a project with estimate of cost of improvement for obtaining 28 feet of water from the city of Savannah to the sea was submitted and is outlined in Appendix N 1, Annual Report of the Chief of Engineers for 1888.

On June 30, 1890, a new project was submitted providing for a mean high-water depth of 26 feet from the city to the sea. This project, which is printed as part of Appendix O, Report of the Chief of Engineers for 1890, was adopted July 22, 1890, its estimated cost being $3,500,000, exclusive of former appropriations. The work contemplated by it was reported practically completed at the end of the fiscal year of 1896, and since then only repair work and dredging have been carried on in accordance with it.

In compliance with requirements of the river and harbor act of August 18, 1894, a modified plan of improvement was submitted December 7, 1894, providing for a detached extension of the Oyster Bed training wall, for the purpose of sheltering the anchorage in Tybee Roads, as well as for protecting the ship channel over the outer part of Tybee Knoll against the destructive action of heavy storms. This project, which is printed as part of Appendix M 1, Annual Report of the Chief of Engineers for 1895, was authorized by law on June 3, 1896, its estimated cost being $992,250.

The entire amount expended on the improvement of Savannah Harbor from its commencement to June 30, 1897, was $5,368,813.75.

For a summary of past work, see page 1492 of the Report of the Chief of Engineers for 1891, and pages 1213 and 1218–1220 of the same officer's report for 1896.

The amount expended under the project of 1890 up to June 30, 1896 was $3,460,049.99, and had resulted in a channel from the city down to the sea of 20 feet depth at mean low water and 26 feet depth at mean high water. Vessels drawing 24 feet have left the harbor on ordinary tides without difficulty.

The river and harbor act of June 3, 1896, contained an appropriation of $5,000 for continuing the improvement of Savannah Harbor, with the following provisions:

Provided, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary to complete the project of further improvement recommended by Capt. O. M. Carter in his reports of December 7, 1894, and July 1, 1895, and to complete the project for the steamboat channel between Beaufort, S. C., and Savannah, Ga., recommended by Capt. O. M. Carter in his report of December 4, 1895, and mentioned in that report as route two; to be paid for as appropriations may from time to time be made by law, not to exceed the amount of $1,000,000, exclusive of amount herein or heretofore appropriated.

The expenditures authorized are $93,950 less than the estimated cost of both works.

During the fiscal year just ended the work contracted for under the provisions of this act has been continued, the total amount expended under the present project up to June 30, 1897, amounting to $33,702.17. The total amount expended under the present project up to June 30, 1898, amounted to $367,664.58. The detached extension of the Oyster Bed training wall was lengthened 1,736 feet, making its entire length 6,986 feet, with probably an average depth of 6 feet at mean low water over it. The channel leading from Savannah River into Wrights River was dredged to a depth of somewhat more than 7 feet at mean low water. Dredging was also done above the city (City Hall), at the upper and at the lower end of Marsh Island Channel, where shoaling had taken place. The channel was deepened to 18 feet at mean low water at the former, and to 21 feet at the latter point.

Extensive shoaling has taken place since the project of 1890 was completed two years ago. A recent examination indicates that it amounts to 675,000 cubic yards, or 337,500 cubic yards per year. At present prices it will therefore take about $43,875 annually to maintain the channel to the depth of 20 feet at mean low water. The shoalest place between Savannah and the ocean at the close of the fiscal year is at the lower end of Long Island crossing, where there is about 17½ feet at mean low water.

In 1872 the tonnage of vessels arriving and clearing at Savannah Harbor was somewhat more than 1,000,000; the total value of imports and exports about $34,000,000. Cotton, lumber, wool, hides, naval stores, and rice were principally dealt in. In 1890 the total tonnage had increased to about 2,000,000, and the value of imports and exports to $152,000,000. Besides the articles named above, fruit, produce, and iron were handled extensively. In the calendar year 1897 the total tonnage was about 2,100,000, and the value of foreign imports and exports about $29,300,000.

It is estimated that $50,000 will be required to maintain the improvement during the fiscal year ending June 30, 1900.

July 1, 1897, balance unexpended		$365,782.89
Amount appropriated by sundry civil act approved July 1, 1898		450,000.00
		815,782.89
June 30, 1898, amount expended during fiscal year		333,962.41
July 1, 1898, balance unexpended		481,820.48
July 1, 1898, outstanding liabilities	$78,035.11	
July 1, 1898, amount covered by uncompleted contracts	*619,790.52	
		697,825.63
Amount (estimated) required for completion of existing project		200,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, for continuing improvement		200,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement		50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix O 1.)

2. *Savannah River, Georgia.*—The Savannah River is formed by the junction of the Tugaloo and Keowee rivers and flows in a southeasterly direction to the sea.

A detailed description of the river is found in the report of the examination and survey of the portion above Augusta, printed as House Ex. Doc. No. 213, Fifty-first Congress, first session, and in the report of the survey of the river between Augusta and Savannah, dated June 30, 1890, and printed in Appendix O 2, Annual Report of the Chief of Engineers for 1890, pages 1328–1363.

For the greater part of the year the river is navigable for steamboats drawing from 4 to 5 feet of water, but during the low-water season there are various shoals in the upper part of the river with low-water depths of not more than about 3 feet. The chief obstruction to navigation consists of sand and gravel bars, overhanging trees, snags, and sunken logs.

The original plan for improving Savannah River was submitted in 1880, and is given in Appendix J of the Annual Report of the Chief of Engineers for 1881.

The revised plan of improvement, as outlined in the local engineer's report of June 30, 1890, provides for the establishment of a navigable steamboat channel 5 feet deep at ordinary summer low water between the cities of Augusta and Savannah.

This is to be accomplished by (1) removing sand and gravel bars; (2) regulating portions of the river, revetting caving banks, and closing incipient cut-offs; (3) removing snags and logs from the channel and overhanging trees from the banks of the stream.

The cost of the improvement as given in the project of 1890 is estimated, in round numbers, at $332,000, provided funds are regularly and adequately supplied.

From $3,000 to $5,000 will be required for the annual maintenance of the completed work.

The entire amount expended on the improvement of Savannah River from its commencement in 1880 to June 30, 1896, was $168,500.

The total amount expended under the present project to June 30, 1897, was $81,397.14.

For a summary of the work done under the original project see page 1520 of the Annual Report of the Chief of Engineers for 1891. For a

* This work is carried on under continuing contract.

summary of the work done under the revised project see pages 1503 and 1504 of the same officer's Annual Report for 1897. At the end of the fiscal year 1897 the channel from Savannah to Augusta was in fair condition, some snags requiring removal.

The total amount expended during the fiscal year just closed was $1,579.09, and resulted in removing from the channel all serious obstructions. At the close of the work the river was in good condition at ordinary low water. Since then, however, a number of snags, etc., have become lodged in the channel and require removal.

A detailed statement of the sources whence the commerce of this river is derived is given on page 1331 of the Report of the Chief of Engineers for 1890. Further information is given on page 1504 of the same officer's report for 1897.

Prior to improvement and after the close of the civil war the commerce of the river was unimportant. Since then it has increased at the rate of about $10 for every dollar expended by the United States, and the freight rates have been reduced about 20 per cent. The exports from the river valley are mainly cotton, naval stores, lumber, and wood, while the imports are fertilizers, camp and mill supplies, cotton ties and bagging, and manufactured articles. Excluding logs, timber, and cord wood the annual tonnage is estimated at about 48,000 tons and its value at about $1,730,000.

July 1, 1897, balance unexpended	$8,622.77
June 30, 1898, amount expended during fiscal year	1,579.09
July 1, 1898, balance unexpended	7,043.68
Amount (estimated) required for completion of existing project	270,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	25,000.00

(See Appendix O 2.)

3. *Savannah River above Augusta, Ga.*—The Savannah River is formed by the junction of the Tugaloo and Keowee rivers, and flows in a southeasterly direction to the sea. Above the city of Augusta the river is navigable only by pole boats.

A detailed description of this river is given in the report of the preliminary examination and survey, printed in House Ex. Doc. No. 213, Fifty-first Congress, first session, and reprinted in the Annual Report of the Chief of Engineers for 1890, pages 1484 and 1525.

The Savannah River above the city of Augusta has a very steep slope, and the obstacles to navigation are not only very numerous and extensive, but at places quite dangerous. They consist of rock ledges, isolated bowlders, and bars of sand and gravel, with minimum low-water depths of less than 1 foot.

The original plan for improving the Savannah River above Augusta was submitted in 1879, and is given in Appendix I of the Annual Report of the Chief of Engineers for 1879.

The revised plan of improvement, as outlined in the local engineer's report of January 31, 1890, provides for the establishment between Petersburg and the Locks of a downstream channel 12 to 25 feet in width and navigable during ordinary summer low water (or from nine to ten months of every year) for pole boats drawing 2 feet, and of an upstream channel navigable under the same conditions for pole boats drawing 1.3 feet of water. This is to be obtained by (1) removing logs and overhanging trees; (2) excavating rock, sand, or gravel, and with excavated materials raising crests of ledges; (3) constructing training

walls to increase flow of water through sluices. The cost of improvement is estimated at $23,000, provided the money is all made available at once, or at $33,000 if supplied in smaller amounts.

The entire amount expended on the improvement of Savannah River above Augusta from the commencement in 1880 to June 30, 1897, was $54,770.91.

The total amount expended under the present project up to June 30, 1897, was $15,770.91. For a special history of work done under the original project see page 1032 of the Annual Report of the Chief of Engineers for 1888. For a summary of the work done under the revised project see pages 1506 and 1507 of the same officer's report for 1897.

At the close of the fiscal year 1897 the channel above Augusta was in fair condition, some snags requiring removal.

No work has been done during the fiscal year just ended. The channel requires clearing.

In 1876–77 about 2,000 tons of freight went upstream from Augusta, and about 12,000 bales of cotton came down. In the report of 1888 the down-going freight was estimated at about 5,000 bales of cotton, and in 1897 the total freight carried on the river, excluding timber, amounted to about 1,500 tons.

July 1, 1897, balance unexpended	$3,229.09
July 1, 1898, balance unexpended	3,229.09
Amount (estimated) required for completion of existing project	14,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix O 3.)

4. *Darien Harbor, Georgia.*—About 12 miles above the town of Darien the Altamaha River divides into several branches. The northerly main branch forms the Darien River. That portion of Darien River between Darien and Doboy Sound is known as Darien Harbor.

Darien Harbor in its original condition was more or less obstructed at seven points by shoals, on which were found minimum mean low-water depths of from 6.4 to 10.6 feet. The shoals covered a total distance of 9.7 miles. The reaches between the shoals carried depths nowhere less than 12 feet at mean low water. The mean rise and fall of tide in the harbor is about 6.5 feet.

Operations for improving this harbor have been carried on in accordance with a project of improvement submitted to the Chief of Engineers by General Gillmore, the officer then in charge, dated January 30, 1885, as printed in Appendix N 16, Annual Report of the Chief of Engineers for 1885. It contemplates the establishment of a navigable channel 12 feet deep at mean low water between Darien and Doboy. The estimated cost of the improvement is $170,000. No work was done under the existing project prior to the fiscal year ending June 30, 1891.

The entire amount expended on the improvement of Darien Harbor from its commencement in 1878, when, by act of Congress of June 18, 1878, the sum of $8,000 was appropriated for dredging up to June 30, 1897, was $102,883.59.

The total amount expended under the present project up to June 30, 1897, was $94,883.59.

For a summary of past work see pages 1508 and 1509 of the Annual Report of the Chief of Engineers for 1897. At the end of the fiscal year 1897 the works of construction were all in good condition, but some settlement had taken place. The practicable channel depth was

nowhere less than 11½ feet at mean low water, excepting at Shoal No. 1, where no work had been done and where it was only about 9½ feet.

So far as known the channel depth is in the same condition as at the end of the last fiscal year.

The ingoing and outgoing tonnage for 1878 was estimated at about 200,000, and the value of the exports at between $600,000 and $700,000. In 1897 the total annual trade was estimated at about 165,000 tons, valued at $1,090,000, not including a large amount of timber passing through Darien Harbor.

July 1, 1897, balance unexpended	$116.41
June 30, 1898, amount expended during fiscal year	116.41
Amount (estimated) required for completion of existing project	75,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix O 4.)

5. *Altamaha River, Georgia.*—The Altamaha River is formed by the junction of the Oconee and Ocmulgee rivers in the southeastern part of Georgia and flows in a southeasterly direction to the sea.

A detailed description of this river is given in the report of a survey, dated June 12, 1890, which is printed as part of Appendix O, Annual Report of the Chief of Engineers for 1890, pages 1327–1386.

The chief obstruction to the navigation of the Altamaha River consists in rock ledges, sand bars, overhanging trees, snags, and sunken logs. The rock ledges were confined to the upper portion of the stream, while the other obstructions were found throughout its entire course. The low-water depths at some points did not exceed 1 foot.

The original plan for improving the Altamaha River was submitted in 1880, and is given in Appendix J of the Annual Report of the Chief of Engineers for 1881.

The revised plan of improvement, outlined in the local engineer's report of June 12, 1890, provides for the establishment of a navigable steamboat channel, 3 feet deep at ordinary summer low water, between the junction of the Oconee and Ocmulgee rivers and the town of Darien.

This is to be accomplished by (1) removing rock shoals and sand bars; (2) building deflecting dikes and closing incipient cut-offs; (3) removing snags and logs from the channel and overhanging trees from the banks of the stream; (4) revetting caving banks.

The cost of the improvement as given in the project of 1890 is estimated, in round numbers, at $129,000, provided funds are regularly and adequately supplied.

From $3,000 to $5,000 will be required for the annual maintenance of the completed work.

The entire amount expended on the improvement of Altamaha River from its commencement in 1881 to June 30, 1897, was $114,251.32.

The total amount expended under the present project to June 30, 1897, amounted to $44,474.73.

For a history of work done under the original project, see page 1246 of the Annual Report of the Chief of Engineers for 1889. For a summary of work done under the revised project, see page 1514 of the same officer's report for 1897.

At the end of the fiscal year 1897 the works of improvement were in good order and the channel was in fair condition, some snags requiring removal.

No work has been done during the fiscal year just ended; the channel requires clearing.

The commerce of the river before the improvement was begun amounted to about 100,000 tons annually, valued at about $1,000,000. For 1897 it was estimated at 22,000 tons, valued at $540,000, aside from a very large amount of lumber and timber.

July 1, 1897, balance unexpended	$5,748.68
June 30, 1898, amount expended during fiscal year	485.77
July 1, 1898, balance unexpended	5,262.91
Amount (estimated) required for completion of existing project	107,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix O 5.)

6. *Oconee River, Georgia.*—The Oconee River rises in the northeastern part of Georgia, flows in a southeasterly direction, and unites with the Ocmulgee to form the Altamaha. A detailed description of this river is given in the report of the preliminary examination and survey, printed as House Ex. Doc. No. 211, Fifty-first Congress, first session, and reprinted in the Annual Report of the Chief of Engineers for 1890, pages 1430 and 1432.

For the greater part of the year the river is navigable for steamboats drawing from 3 to 4 feet, but during the low-water season there are various shoals with low-water depths of not more than 2 feet. The chief obstructions to navigation consist of sand bars, rock shoals, overhanging trees, snags, and sunken logs.

The original plan for improving the Oconee River was submitted in 1875, and is given in the Annual Report of the Chief of Engineers for that year. That plan was modified in 1878, 1880, and 1888.

The present plan of improvement, outlined in the report of February 5, 1890, provides for the establishment of a navigable steamboat channel 3 feet deep at ordinary summer low water from Milledgeville to the river's mouth.

This is to be accomplished by (1) removing rafts, rock shoals, and sand bars; (2) enlarging portions of the river, revetting caving banks, and closing incipient cut-offs; (3) removing snags and logs from the channel and overhanging trees from the banks of the stream.

The cost of the improvement is estimated at $171,000, provided funds are regularly and adequately supplied.

From $1,000 to $5,000 will be required for annual maintenance of the completed work.

The entire amount expended on the improvement of Oconee River from its commencement in 1878 to June 30, 1897, was $109,628.58.

The total amount expended under the present project to June 30, 1897, was $64,829.76.

For a history of work done under the original project, see page 1253 of the Annual Report of the Chief of Engineers for 1889. For a summary of work done under the present project, see pages 1516 and 1517 of the same officer's report for 1897.

At the end of the fiscal year 1897 the channel was in fair condition, a number of snags requiring removal.

The total amount expended during the fiscal year just ended was $2,718.43, and resulted in removing obstructions from the channel and putting the same in good condition from the Forks up to a point 4 miles below the Central Railroad Bridge (station 104 miles). Above this point the channel is much obstructed and in great need of being cleared.

At the end of the fiscal year the channel was in fair condition.

No reliable statistics of the commerce of the river before the improvement was begun are available. From 1880 to 1885 the information at hand only mentions cotton, guano, rosin, spirits of turpentine, and merchandise, all of these in considerable quantities.

In 1897 the tonnage of freight was estimated at 22,550, valued at about $800,000; besides this about 180,000 tons of cypress and pine timber, valued at about $690,000, was rafted down the river.

July 1, 1897, balance unexpended	$5,371.42
June 30, 1898, amount expended during fiscal year	2,718.43
July 1, 1898, balance unexpended	2,652.99

Amount (estimated) required for completion of existing project	122,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix O 6.)

7. *Ocmulgee River, Georgia.*—The Ocmulgee River is formed by the junction of the South and Yellow rivers, about 20 miles below Covington, and flows thence in a southeasterly direction about 250 miles, where it unites with the Oconee to form the Altamaha. A detailed description of this river is found in the report of the preliminary examination and survey, printed as House Ex. Doc. No. 215, Fifty-first Congress, first session, and reprinted in the Annual Report of the Chief of Engineers for 1890, pages 1455 and 1458.

For the greater part of the year the river is navigable for steamboats drawing from 3 to 4 feet, but during the low-water season there are various shoals with depths of not more than 2 feet. The chief obstructions to navigation consist of rock shoals, sand bars, overhanging trees, snags, and sunken logs.

The original plan for improving Ocmulgee River was submitted in 1876, and is given in the Annual Report of the Chief of Engineers for that year. That project was revised in 1882 and again in 1886.

The present plan of improvement, outlined in the report of February 5, 1890, provides for the establishment of a navigable steamboat channel 3 feet deep at ordinary summer low water from Macon to the river's mouth.

This is to be obtained by (1) removing rock shoals and sand bars; (2) closing incipient cut-offs and revetting caving banks; (3) removing snags and logs from the channel and overhanging trees from the banks of the stream.

The cost of the improvement, as given in the project of 1890, is estimated at $210,000, provided funds are regularly and adequately supplied.

From $1,000 to $5,000 will be required for the annual maintenance of the completed work.

The entire amount expended on the improvement of Ocmulgee River from its commencement in 1876 to June 30, 1897, was $149,975.24.

The total amount expended under the present project to June 30, 1897, was $70,720.19.

For a detailed history of the work done under the original project see page 1258 of the Annual Report of the Chief of Engineers for 1889. For a summary of the work done under the present project see pages 1519 and 1520 of the same officer's Annual Report for 1897.

At the end of the fiscal year 1897 the channel was in fair condition, a number of snags requiring removal.

The total amount expended during the fiscal year just closed was $4,463.76, and resulted in removing all serious obstructions from the channel, so that at the end of work it was in good condition from the Forks up to Macon. Since then, however, a number of snags have lodged in it, and at the close of the fiscal year the river was in need of further clearing.

No reliable statistics of the commerce of the river before the improvement was begun are available. It is stated in 1889 to have consisted principally of naval stores, cotton, merchandise, camp supplies, etc., and also of timber rafted down the river. In 1887–88 about 14,300 barrels of turpentine and 50,700 barrels of rosin are stated to have been shipped, while probably $300,000 worth of timber was rafted down the river. In 1896 the tonnage was estimated at 120,000 tons, valued at $2,000,000. No data are available for 1897.

July 1, 1897, balance unexpended	$4,524.76
June 30, 1898, amount expended during fiscal year	4,463.76
July 1, 1898, balance unexpended	61.00

Amount (estimated) required for completion of existing project	156,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix O 7.)

8. *Brunswick Harbor, Georgia.*—About 2 miles above the city of Brunswick Turtle River is divided by Buzzard Island into two branches, the smaller one, flowing to the eastward of the island and upon which the city of Brunswick is situated, being known as East River, the other retaining the name of Turtle River. These streams unite again about 1½ miles below the city to form Brunswick River. The lower part of East River forms what is known as the harbor of Brunswick.

Turtle and Brunswick rivers have low-water depths of from 4 to 6 fathoms. Over the shoal in East River in front of the city there was, when the existing project of improvement was adopted, a low-water depth of only 1½ fathoms. The mean rise and fall of tide is about 6.6 feet. Operations for the improvement of this harbor have been carried on in accordance with a project of improvement prepared by General Gillmore, the officer then in charge, and printed as Appendix M 12, Annual Report of the Chief of Engineers for 1886. This project is an enlargement and a modification of a previous one submitted by the same officer and printed as Appendix J 7, Annual Report of the Chief of Engineers for 1880.

The following comprise the main features of the plan of improvement:

(1) A training wall projecting from the most easterly point of Buzzard Island and located approximately parallel to and 1,000 feet or less distant from the opposite shore of East River.

(2) A low dam across Turtle River extending obliquely upstream from the upper end of Buzzard Island to the opposite shore of Blythe Island.

(3) Short spur jetties in the lower part of East River.

(4) Dredging in the vicinity of Turtle River Dam and on the shoal in the lower part of East River.

The training walls and spurs were to be constructed of palmetto cribs loaded with stone, or of successive courses of log and brush mattresses loaded with riprap stone. The works were intended to establish and maintain a 15-foot low-water channel across the shoal in East River.

The cost of the original project was estimated at $73,187.50, and as modified at $190,000.

In his report of November 26, 1894, concerning a revision of the project of improving harbor at Brunswick, the local engineer stated that—

> It will be more economical and advantageous to maintain the desired depth of 15 feet at mean low water by keeping the training wall in good condition and by annual dredging than by constructing a dam across Turtle River and further channel contraction.

He also estimated the cost of maintenance at $15,000 per annum, provided that sum be made available each year.

The entire amount expended on the improvement of Brunswick Harbor from its commencement, including an appropriation of $10,000 made in 1836 for dredging, to June 30, 1897, was $218,268.34, of which $10,000 was for maintenance.

The amount expended on the existing project to June 30, 1897, was $18,268.34, and had resulted in the construction of a training wall 4,509 feet long and in the dredging of the channel to 15 feet at mean low water.

At the end of the fiscal year of 1897 the training wall was in good condition and dredging along the city front in East River and in Academy Creek was nearly completed. For a summary of past work see page 1274 of the Report of the Chief of Engineers for 1896 and page 1523 of the report of the same officer for 1897.

The total amount expended during the fiscal year just ended was $6,107.22.

At the close of the work, which consisted in dredging, there was an available channel of 12½ feet depth at mean low water in Academy Creek and of 15 feet depth at mean low water along the city front in East River. So far as known, the channel has not deteriorated.

Before the improvement (in 1880) the annual tonnage of the port of Brunswick was about 100,000, consisting chiefly of lumber, naval stores, wood, rice, and sundry provisions, and valued at about $1,700,000. In 1897 the shipments of lumber, railroad ties, cotton, and naval stores amounted to about 693,000 tons, and were valued at more than $12,500,000.

July 1, 1897, balance unexpended	$6,731.66
June 30, 1898, amount expended during fiscal year	6,107.22
July 1, 1898, balance unexpended	624.44
Amount (estimated) required for completion of existing project	(*)
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix O 8.)

9. Inside water route between Savannah, Ga., and Fernandina, Fla.—The location of this route is shown by a dotted line on Coast Survey Charts Nos. 156 and 157, and a detailed description of it and its original condition is given in Appendix N 12, Annual Report of the Chief of Engineers for 1892, pages 1311–1326.

The distance from Savannah to Fernandina by the inside route just described is about 160 miles.

Touching at Darien en route increases the distance by about 20 miles, and at Brunswick by about 12 miles.

* Indeterminate.

In its original condition the channel depth was less than 5 feet at mean low water in some places.

The original project of improvement, adopted in 1892, provides for the establishment of a channel 7 feet deep at mean low water between Savannah, Ga., and Fernandina, Fla. This is to be accomplished by the improvement of Romerly Marsh, Mud River, Little Mud River, and Jekyl Creek by means of dredging and the construction of closure dams and training walls of brush mattresses loaded with riprap stone. The estimated cost of the improvement is $105,000, provided that the entire sum is made at once available. If funds are made available in smaller amounts the cost of the improvement will be increased.

The total amount expended up to June 30, 1897, was $36,489.49. Up to this time operations had been entirely confined to Jekyl Creek. A summary of them will be found on page 1536 of the Report of the Chief of Engineers for 1897. Besides this the sum of $24,000, appropriated specifically for the improvement of Jekyl Creek, had been expended for that purpose. At the end of the fiscal year 1897 the available channel depth through Jekyl Creek had deteriorated from 6 feet to 5 feet at mean low water.

The total amount expended during the fiscal year just ended was $11,159.94. Work was confined to Jekyl Creek and Mud River. At the former place the channel over the bar at the mouth was deepened to 7 feet at mean low water, and the channel in the creek was deepened to 8 feet at mean low water. At the end of the past fiscal year the latter is stated to have shoaled somewhat. The dredging in Mud River was done to connect the deep water of Sapelo Sound with that of New Tea Kettle Creek by a channel 7 feet deep at mean low water. At the end of the fiscal year the work had not been entirely completed. The dredged channel in the entrance (east range), where only one cut, 40 to 45 feet wide, was made, was claimed by local steamboat men to have shoaled in some places and to be not much used on account of its narrowness and the lack of suitable ranges.

The value of the commerce passing through this route was estimated in 1890 at between $200,000 and $400,000 per annum. For 1897 no data are available.

July 1, 1897, balance unexpended		$12,510.51
June 30, 1898, amount expended during fiscal year		11,159.94
July 1, 1898, balance unexpended		1,350.57
July 1, 1898, outstanding liabilities	$540.95	
July 1, 1898, amount covered by uncompleted contracts	759.62	
		1,300.57
July 1, 1898, balance available		50.00

Amount (estimated) required for completion of existing project	56,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix O 9.)

10. Removing sunken vessels or craft obstructing or endangering navigation.—During the fiscal year just ended there were removed, under special authority of the Secretary of War, the wreck of a wooden vessel and a raft of logs from the channel in Darien Harbor, Georgia, the work being done by hired labor at a cost of $591.07.

There was also removed, under special authority of the Department, the wreck of the steamer *R. L. Mabey* from the channel in Brunswick Harbor, the work being done by contract at a cost of $895.

There was also removed, under special authority of the Department, the wreck of the steamer *Allen* from the channel in Ocmulgee River, the work being done by hired labor at a cost of $113.07. The cost of taking out and depositing on the bank boiler and engine ($56.54) was refunded by the owner when these articles were turned over to him. This amount was placed to the credit of the Treasurer of the United States.

(See Appendix O 10.)

IMPROVEMENT OF CUMBERLAND SOUND, GEORGIA AND FLORIDA, AND OF CERTAIN RIVERS AND HARBORS IN FLORIDA.

This district was in the charge of Lieut. Col. W. H. H. Benyaurd, Corps of Engineers, having under his immediate orders Capt. Robert P. Johnston, U. S. Volunteers, first lieutenant, Corps of Engineers, to February 1, 1898, and since June 19, 1898, and Maj. William W. Harts, U. S. Volunteers, first lieutenant, Corps of Engineers, since April 28, 1898.

1. Cumberland Sound, Georgia and Florida.—This work was in the charge of Capt. O. M. Carter, Corps of Engineers, to July 20, 1897, and of Capt. Cassius E. Gillette, Corps of Engineers, from July 20, 1897, to December 6, 1897. The available depth of the entrance in its unimproved condition varied from 11 to 12.5 feet at mean low water. The mean rise and fall of tide is 5.9 feet. The original plan of improving the entrance was submitted in 1879, and is given in the Annual Report of the Chief of Engineers for that year. A revised plan was submitted in 1891. A second revision of the plan of improvement was submitted in 1895, and is printed in Annual Report of the Chief of Engineers for 1896, page 1289 et seq. It contemplates the construction of two jetties, composed of riprap stone, with a hearting of small stone, resting upon a foundation mattress of brush, starting, respectively, from the shores on opposite sides of the entrance and extending seaward across the bar. These jetties are intended to establish a mean low-water channel across the bar not less than 19 feet in depth.

This project was authorized by the river and harbor act of June 3, 1896. The cost of the improvement was originally estimated at $2,071,023, as revised in 1891 at $2,079,500, and as revised in 1895 at $2,350,000 for completion. Revision of the estimates was rendered necessary from the fact that funds had been supplied irregularly and in entirely inadequate amounts for the proper prosecution of the work.

Previous to the adoption of the project of 1895 the sum of $932,500 had been expended on the improvement, resulting in carrying the north jetty 18,308.8 feet and the south jetty 10,062.48 feet seaward. There had been used in this work 574,276 square yards of mattresses, 133,866.74 cubic yards of riprap stone, and 2,071.8 cubic yards of oyster shells.

Under the provisions of the river and harbor act of June 3, 1896, a contract was entered into October 8, 1896, for all jetty work required for completion of the improvement. Work was commenced on December 7, 1896, and continued to October 9, 1897, on which date the contractor suspended operations and has not since resumed.

Under this contract, up to June 30, 1897, the north jetty was extended 1,577.8 feet to station 19,862.8, and the south jetty was extended 3,792.2 feet to station 13,854.7. There had been used in this work 346,287.72 square yards of mattresses, 9,437.96 cubic yards of third-class and 8,018.35 cubic yards of fourth-class riprap stone.

The total amount expended on the improvement of Cumberland Sound up to June 30, 1897, was $936,670.99, of which $4,170.99 was under the project of 1895 and the provisions of the act of June 3, 1896. No payment had been made to the contractor.

During the past fiscal year the north jetty was extended 549.6 feet to station 20,412.4. There were placed in the north jetty 111,868.75 square yards of mattresses, 375.63 cubic yards of third-class and 7,616.93 cubic yards of fourth-class riprap stone. And in the south jetty 1,361.81 cubic yards of fourth-class riprap stone was used.

Work to the total amount of $604,685.21 (subject to deductions) has been performed under the present contract. The contractor has been paid $345,000, leaving a balance due of $259,685.21 (subject to deductions). No funds were available June 30, 1898, for making payment.

The construction of the jetties has as yet had no effect in establishing or maintaining a channel over the bar, not having been far enough advanced to control the currents and wave action. The sailing channel still crosses the south jetty. With the funds made available by the appropriation of $50,000, made by the deficiency appropriation act approved July 19, 1897, the shoal places in this channel were twice dredged out during the fiscal year. Efforts were also twice made to deepen the cut through the south jetty from 14 to 17 feet at mean low water, but the plant available did not accomplish much. A plant better adapted to the work was, however, secured on June 30, and will be used in an endeavor to complete the removal of the necessary material during July. A channel with least depth of 17 feet at mean low water over the ocean bar and to the jetty crossing was completed in June. Vessels drawing 14½ feet could enter at mean low water on June 30, 1898.

There was dredged from the sailing channel during the year 87,311 cubic yards of material. From the cut through the south jetty about 130 cubic yards of rock, 23 logs, and 7 binders were removed.

Before improvement (in 1879) the annual in and out bound tonnage at Fernandina was about 300,000, and the value of imports and exports about $2,500,000; lumber, naval stores, and cotton being the principal articles. In 1896 these figures had risen to about 400,000 and about $9,500,000, respectively. In addition to the former articles of export, a considerable amount of phosphate rock was shipped coastwise and to foreign ports.

July 1, 1897, balance unexpended		$350,829.01
Amount appropriated by deficiency act approved July 19, 1897		50,000.00
Amount appropriated by sundry civil act approved July 1, 1898		450,000.00
		850,829.01
June 30, 1898, amount expended during fiscal year		362,924.51
July 1, 1898, balance unexpended		487,904.50
July 1, 1898, outstanding liabilities	$261,437.87	
July 1, 1898, amount covered by uncompleted contracts	* 1,536,564.79	
		1,798,002.66
Amount (estimated) required for completion of existing project		1,495,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900		400,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix P 1.)

* This work is carried on under a continuing contract.

2. *St. Johns River, Florida.*—Previous to the commencement of improvement the mean low-water channel depth across the bar at the mouth varied from 5 to 7 feet, with a tidal range of 5.22 feet. This bar is formed of sand, and was extremely dangerous, as the channel across it shifted continuously north and south through a range of about 1 mile.

The least mean low-water channel depth in the river was about 11.5 feet, all obstructions being sand or mud. The tidal range in the river varies from about 4.5 feet at the mouth to about 1 foot at Jacksonville.

The original plan of improvement contemplated the formation of a continuous channel with a mid depth of not less than 15 feet at mean low water from Jacksonville to the ocean, a distance of about 27.5 miles. The two points where work was required to gain this depth were at the bar at the mouth and in a reach of the river near Dames Point, 12 miles above. The work was divided into two parts:

1. The formation of a channel across the bar at the mouth by the concentration and direction of the tidal currents by two jetties to start from the opposite shores at the entrance, and to converge until, on the bar, their outer ends should be approximately parallel and 1,600 feet apart.

2. The improvement of the Dames Point reach by dredging, and the construction of works of protection, under a project approved June 11, 1891, and modified March 28, 1892.

It was estimated that the cost of obtaining a channel over the bar 15 feet in depth at mean low water under the approved project would be $1,306,409, and for improving the river in accordance with the approved modified project, which contemplated a navigable channel of 18 feet mean low-water depth from inside the bar to Jacksonville, would be $324,000.

The work done on this river and bar having been in a marked degree successful, and having demonstrated the possibility of obtaining a channel of much greater depth than that originally contemplated, a plan was submitted, under authority of the river and harbor act of August 18, 1894, for continuing the work of improvement with a view of obtaining a channel depth of 24 feet from Jacksonville to the ocean. This project contemplates the dredging of a channel 300 feet wide and 24 feet deep through all shoals, and the construction of training dikes in the river proper, at an estimated cost of $600,000; also the extension of the north jetty at the mouth of the river 1,500 feet, and of the south jetty 500 feet, and raising these jetties throughout their entire length, at an estimated cost of $1,509,750; in all, $2,109,750.

Under the provisions of the river and harbor act of June 3, 1896, this project was adopted, and $200,000 was appropriated for continuing the improvement in accordance therewith.

The amount expended on this improvement to June 30, 1897, was $1,452,498.42.

Improvement of the river between the bar and Jacksonville was effected by the citizens of Duval County, Fla., at a cost of $303,206.25, and consisted of forming a channel 200 feet wide and 18 feet deep at low water by dredging and construction of training dikes.

There has been no work done in the river proper since the completion of that done by Duval County in 1894. The dredged cuts have maintained themselves very well, except the two lower ones, where shoaling to such extent has taken place as to make the available depth only about 13 feet at low water.

The sum of $50,000 was reserved from the appropriation of $200,000 made by the act of June 3, 1896, and with the balance of $150,000 work

was carried on on the jetties under a contract entered into January 2, 1897. Work under this contract was completed November 25, 1897. There was placed in the jetties a total of 45,131.23 tons of first-class and 7,699.73 tons of second-class stone. The south jetty was built up to the level of mean high water from the shore to Station 8200, and to the level of mean low water from there to the outer end, a distance of 2,512 feet, and the north jetty was built to a height of from 3 to 7 feet above mean low water from Station 9450 to the outer end, a distance of 1,484 feet.

The remainder of the north jetty has been in about the same condition since 1892. Its crest from the shore to Station 5000 is at mean low water; from Station 5000 to Station 8000 about 2 feet below mean low water, and from Station 8000 to Station 9450 from 3 to 7 feet below mean low-water level. The total length of the north jetty is 10,934 feet and that of the south jetty is 10,712 feet, not including the shore extensions.

There has been a gradual shoaling on the bar since work on the jetties was stopped. There is now an available channel depth of 13 feet at mean low water across the bar, as compared with 14¾ feet last year. It is possible that this shoaling is only temporary, but it shows the importance of extending the north jetty.

A comparison of a map of a survey of the bar entrance made in June, 1898, with a map of a survey made in December, 1897, shows a shoaling from 15 feet to 13 feet depth at mean low water and a decided increase in the area included between the inner and outer 12-foot contours. There is every indication that this shoaling is due to the sand movement around the present end of the north jetty, and that it would cease were this jetty extended and built up to a height sufficient to prevent the waves breaking in over the bar.

The following table shows the condition of commerce in 1880, when the work of improvement began; in 1886, just prior to the time the effect of the improvement was perceptible on navigation, and during the past three years:

Year.	Vessels entered.			Vessels cleared.		
	Number.	Aggregate tonnage.	Average tonnage.	Number.	Aggregate tonnage.	Average tonnage.
1880	383	165,731	433	418	172,975	414
1886	383	123,176	322	271	116,044	428
1895	343	328,008	927	350	340,153	972
1896	378	358,946	923	374	360,311	964
1897	463	461,941	997	445	457,097	1,027

July 1, 1897, balance unexpended	$164,501.58
June 30, 1898, amount expended during fiscal year	112,593.47
July 1, 1898, balance unexpended	51,908.11
July 1, 1898, outstanding liabilities	38.75
July 1, 1898, balance available	51,869.36
Amount (estimated) required for completion of existing project	1,909,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	200,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix P 2.)

3. *Volusia Bar, Florida.*—The bar is located at the south end, or head, of Lake George, St. Johns River, about 162 miles from the mouth.

An examination of the locality with a view to improvement was made

in 1879, and a plan was presented which contemplated the construction of two jetties carried out beyond the bar with their outer ends from 200 to 250 feet apart, with a view of obtaining a depth of 6 feet at low water over the bar.

Before any improvement was commenced the channel over the bar was very crooked and had a least depth varying from 3½ to 4½ feet.

The plan above presented was modified more or less in succeeding years, still maintaining the jetties, and dredging if necessary to assist in gaining the depth.

In 1887 this project was modified so as to limit the depth to 5 feet, already attained, which was deemed sufficient for the steamers navigating the Upper St. Johns River.

With the appropriations made since the inception of the project two jetties have been built starting from opposite sides of the river bank at the south edge of the lake and converging until upon the bar they are 230 feet apart. The east jetty is 3,400 feet long and the west jetty 2,200 feet. They are built to the level of mean low water throughout nearly their entire lengths. Two rows of firmly set piles provided with waling pieces confine boats to a 100-foot channel across the crest of the bar. Two hundred and fifty-eight cubic yards of material was dredged and the fender piles were repaired in November, 1893.

With the money made available for this work by the two appropriations of $1,000 each made by acts of August 18, 1894, and June 3, 1896, respectively, dredging to the extent of 4,242 cubic yards was done by contract in September and October, 1896. This resulted in a channel through the shoal near the ends of the jetties having a least width of 80 feet.

An appropriation of $2,000 is required each year to keep the bar in a navigable condition.

The amount expended to June 30, 1897, was $29,000.

No work has been done during the fiscal year, no funds being available. The maximum draft that can be carried through the improved channel at low water is 5 feet.

The improvement has had no effect on commercial interests except to render navigation safer and more reliable.

Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement..... Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	$2,000.00

(See Appendix P 3.)

4. *Ocklawaha River, Florida.*—The Ocklawaha River has its source in Lake Apopka, central Florida, flows slightly west of north for about 104 miles, measured along the axis of the channel, then almost due east for 21 miles farther, when it unites with the St. Johns River. The Ocklawaha River is the principal outlet of a number of large lakes, the aggregate area of which is about 175 square miles.

From Lake Griffin down for a distance of about 28 miles the river flows through a wide savanna submerged about 1 foot under water and covered with a dense growth of saw grass. On this reach the river averages from 30 to 40 feet in width and has a least channel depth of about 5 feet; the current is very sluggish.

The impediments to navigation on this portion of the river are the numerous bends, the narrow channel, floating islands, and eelgrass. From the savanna to the mouth, a distance of about 58 miles, the banks are covered with a dense growth of cypress and other timber. On this reach the river averages from 60 to 70 feet in width, and the least chan-

nel depth is 4 feet. The average velocity of the current is considerably greater than on the upper river, being about 1.3 feet per second. The principal obstructions to navigation here are snags and overhanging trees.

The project for the improvement of this river consists in removing snags, overhanging trees, floating islands, and other obstructions of like character, so as to give a fair navigable channel of 4 feet depth from the mouth to Leesburg, at the head of Lake Griffin, a distance of 94 miles. The estimated cost of this work is $26,000.

All appropriations made prior to the one in act of June 3, 1896, have been expended in removing snags and overhanging trees. The result has been to place the river in a fairly navigable condition for a distance of about 60 miles from its mouth.

The amount expended upon this improvement to June 30, 1897, was $14,000. This amount includes $4,000 appropriated for maintenance. The appropriation of $3,000 for maintenance, made in act of June 3, 1896, will be expended in removing such logs and overhanging trees as have become obstructions during the cessation of work.

No work has been done during the fiscal year. Bids were opened on January 29, 1898, for furnishing a plant with which to do the work, but were all rejected as too high. It was proposed to do the work with the U. S. snag boat *Suwanee* as soon as her services should become available, but the war with Spain has prevented bringing her around from the west coast of Florida.

The maximum draft that can be carried at low water is 4 feet.

The improvement of this river has had no effect on commercial interests except to render navigation more safe. If the project were completed, large amounts of agricultural products and general merchandise would be carried by water from Leesburg to Jacksonville.

July 1, 1897, balance unexpended	$3,000.00
July 1, 1898, balance unexpended	3,000.00
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, including maintenance	9,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix P 4.)

5. *St. Augustine Harbor, Florida.*—The approved project is to protect the shores on the north and south sides of the entrance from erosion, the work consisting of groins constructed of riprap on brush foundation and capped with concrete.

Work was begun in 1889. Seven groins in all have been built, three on the north beach and four on Anastasia Island, on the south side of the entrance. Their lengths vary from 220 to 549 feet.

The erosion of the shore line has, with slight exceptions, been stopped. The outer portion of the north beach has been built out to the extremities of the groins.

The appropriation made in act of August 18, 1894, has not been expended, as there has seemed to be no immediate necessity for further work to protect the beach. The amount available is reserved for emergencies that may arise as the result of storms or a sudden wearing away of the shore line.

The amount expended up to June 30, 1897, was $64,999.90.

This improvement, being confined to the protection of the outer shore lines of the entrance, has had no effect whatever on the character and

amount of commerce, which is practically nothing as far as water transportation is concerned.

The maximum draft that can be carried over the bar at mean low water varies from 6 to 9 feet.

July 1, 1897, balance unexpended	$6,000.10
July 1, 1898, balance unexpended	6,000.10
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	24,000.00

(See Appendix P 5.)

6. Indian River, Florida.—Operations under separate projects and appropriations have been carried on at three localities on the river, viz: the portion of the river proper between Goat Creek and Jupiter Inlet, Negro Cut and Indian River Inlet, and Jupiter Inlet.

Between Goat Creek and Jupiter Inlet.—Under the provisions of the river and harbor act of 1890 a survey of this portion of Indian River was made and a project adopted which contemplated making a continuous channel 5 feet deep at low water and at least 75 feet wide in the straight reaches, with as much greater width in the turns as may be required, at an estimated cost of $44,000.

The Florida Coast Line Canal and Transportation Company possessed a franchise granted by the State of Florida which included this portion of the river and had dredged a continuous navigable channel along it 50 feet wide and 5 feet deep. After considerable delay the canal company made the necessary relinquishment of the rights they possessed under their franchise, and work under the appropriation of July 13, 1892, was commenced by the United States hydraulic dredge *Suwanee* July 28, 1895. The channel previously dredged by the Florida Coast Line Canal and Transportation Company was widened at Long Canal, High Bank Canal, Curved Canal, and Conch Bar by dredging a cut 50 feet wide and 6 feet deep along one side. The aggregate length of all the cuts made by the United States was 11,075 feet, and the total amount dredged was 56,665 cubic yards. The amount expended on this part of the river to June 30, 1897, was $15,000.

Negro Cut, Indian River Inlet.—The river and harbor act of August 18, 1894, appropriated $5,000 for dredging at this locality. The urgent deficiency act of March 2, 1895, made a further appropriation of $15,000 for the same work.

A project was adopted contemplating the formation of a channel 100 feet wide and 6 feet deep from the channel of Indian River through Negro Cut to the bar at Indian River Inlet, and the construction of a training wall for its protection, at an estimated cost of $32,775.

The available channel depth before improvement was 1.5 feet.

Dredging was begun with the United States dredge *Suwanee* on January 9, 1896, and the channel called for by the project was completed September 26, 1896. A total of 93,583 cubic yards of material was removed.

The river and harbor act of June 3, 1896, appropriated a further sum of $7,500 for dredging this channel. The amounts previously appropriated were sufficient to complete the projected dredging, and subsequent appropriations should have been made available for the construction of the training wall, which is necessary for the protection of the dredged channel, as contemplated in the project. It being desirable to commence the construction of the training wall, the question as to whether this appropriation could be applied to that purpose was sub-

mitted to the Comptroller of the Treasury, who decided that it was not permissible without further action by Congress.

The amount expended on improvement at Negro Cut to June 30, 1897, was $18,100.51. No work has been done at this locality since September, 1896, pending action by Congress to make the appropriation of $7,500 of June 3, 1896, available for the construction of the training wall. The expenditure during the year was for repair of plant.

Jupiter Inlet.—By act of Congress approved February 26, 1896, an appropriation of $500 was made to open this inlet for the passage of boats and small vessels. An examination of the inlet was made March 15, 1896. It was found that the inlet was entirely closed by a ridge of sand varying in width from 350 to 800 feet at low water, with a crest at an elevation of 7 to 9 feet above mean low water.

The project adopted contemplated making a cut 40 feet wide on the bottom and 2 feet deep at low water. Work was begun September 5 and was satisfactorily completed September 19, 1896. The total amount expended on this part of Indian River to June 30, 1897, was $500. The project was completed.

The maximum draft that can be carried through Indian River is 5 feet at mean low water.

Water transportation on Indian River was temporarily decreased by the extension of the railroad along the river bank to Miami and by the freeze of 1894–95, which destroyed or set back the growth of nearly all the orange and lemon groves. During the past two years, however, a new line of steamers has been running on the river, doing a large business in freight and passengers. The growers of this section have been able to ship their produce by water as far north as Titusville, and thereby effect a considerable saving on incoming and outgoing freight.

INDIAN RIVER, BETWEEN GOAT CREEK AND JUPITER INLET.

Amount (estimated) required for completion of existing project	$29,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

NEGRO CUT, INDIAN RIVER INLET.

July 1, 1897, balance unexpended	$9,399.49
June 30, 1898, amount expended during fiscal year	1,579.02
July 1, 1898, balance unexpended	7,820.47

(See Appendix P 6.)

7. *Caloosahatchee River, Florida.*—An examination of this river with a view to its improvement was made in 1879. In 1887 a survey was made from Lake Okeechobee to the mouth.

The project adopted in 1882 called for deepening the channel by dredging from the mouth to Fort Myers, so as to give a depth of 7 feet at mean low water for a width of 100 feet. In 1886 and 1888 this project was modified so as to include the improvement of the upper river as far as Fort Thompson by the removal of snags and overhanging trees, and by deepening the channel near Beautiful Island to a depth of 4 feet.

Before improvements commenced upon this river there was a practicable channel 5 feet deep at mean low water from the mouth to 4 miles above Myers. The portion of the river which has the characteristics of an estuary was principally obstructed by oyster beds. Above, as far as Fort Thompson, the ruling depth was 3½ feet, on the shoal at Beautiful Island. This portion was obstructed by snags and overhanging trees.

With the money appropriated from 1882 to 1890 the shoals below Myers were dredged to a depth of 7 feet and the channels across the bars marked with suitable piles. Above Myers the shoal at Beautiful Island was dredged to 4 feet and a dike or training wall provided to concentrate the water through the dredged cut. A large number of snags have been removed from this portion of the river.

The appropriations since 1890 have been made for maintenance, and they have been expended in removing such snags and overhanging trees as had become obstructions during the cessation of work, and in repairing the channel marks on the lower portion of the river.

An appropriation of $1,000 annually or $2,000 biennially will be required to keep this river in a fair navigable condition.

The amount expended up to June 30, 1897, was $29,892.25.

During the past fiscal year 6,291 cubic yards of dredged material, 246 snags, and 108 overhanging trees have been removed and 11 channel marks established in maintaining the improvement.

The maximum draft that can be carried at mean low water is 7 feet as far as Myers and 4 feet above Myers.

The deepening and clearing of the river has enabled the growers of vegetables, oranges and other fruits to ship their produce to the railroad at Punta Gorda at rates materially less than those that prevailed before the improvement was begun. The freeze of 1894–95 has shifted the fruit and vegetable industries farther south, and the country tapped by the Caloosahatchee River and tributaries now furnishes a large and growing proportion of the Florida output of these commodities.

July 1, 1897, balance unexpended	$1,707.75
June 30, 1898, amount expended during fiscal year	1,484.00
July 1, 1898, balance unexpended	223.75
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	2,000.00

(See Appendix P 7.)

8. Charlotte Harbor and Pease Creek, Florida.—Work upon this improvement was commenced under an appropriation of $35,000 made by the river and harbor act of September 19, 1890, for "improving, dredging, and deepening the channel of Charlotte Harbor and Pease Creek to the pier at Punta Gorda."

The survey from Boca Grande Pass to Punta Gorda made under this appropriation disclosed a channel depth of 19 feet at mean low water on the bar, 9 feet at the shoals south of Cape Haze, and 10 feet upon the shoals near the wharf at Punta Gorda. The rise of tide is approximately 2 feet.

The approved project contemplates the improvement of the channel so as to give a depth of 12 feet at mean low water from the wharves at Punta Gorda to the pass over a width of 200 feet. The estimated cost was $127,500, reduced in 1896 to $100,000.

Operations have been carried on by dredging with a view of obtaining the width and depth contemplated. The work done under the first appropriation of $35,000 resulted in forming a channel 300 feet wide for a distance of 300 feet in front of the wharves, 160 feet wide for a distance of 4,729 feet, 120 feet wide for a distance of 1,764 feet, where it connects with the 12-foot contour. Over nearly the whole of this length the depth was attained of over 13 feet.

Under the second appropriation, amounting to $20,000, a channel was

formed through the lower shoal near Cape Haze 200 feet wide and 12 to 13 feet deep at mean low water, and through the shoal near Charlotte Harbor Light an available channel depth across that shoal of 11½ feet at mean low water was secured.

The river and harbor act of June 3, 1896, appropriated $20,000 for continuing the improvement. Bids were opened March 10, 1897, to do the work by contract. Only one bid was received, and that at the rate of 29 cents per cubic yard. The bid was accepted, and a contract was entered into March 27, and approved April 16, 1897. Dredging began April 26, and was completed December 14, 1897. There were removed 25,922 cubic yards of material from the shoal near Cape Haze, and 32,678 cubic yards from the shoal near the wharves at Punta Gorda, making a total of 58,600 cubic yards. This work has resulted in making a channel 12 feet deep at mean low water from the wharves at Punta Gorda to Boca Grande Pass. This channel is 200 feet wide for the entire distance, except through the cut across the shoal near the wharves, where the width is 35 feet.

The amount expended up to June 30, 1897, was $57,064.05.

The maximum draft that can be carried is 12 feet at mean low water.

The commerce of Charlotte Harbor has steadily increased since 1891. Most of the increase is due to the development of phosphate mines on Pease Creek.

The commerce consists of cattle, fertilizers, agricultural products, lumber, fish and oysters, phosphate, and general merchandise.

The improvement has resulted in lessening the cost of water transportation, especially that of phosphate. Ships are now able to load to a 12-foot draft at the docks at Punta Gorda, and the amount of freight carried by lighters to the pass has been materially decreased.

July 1, 1897, balance unexpended	$17,935.95
June 30, 1898, amount expended during fiscal year	17,483.17
July 1, 1898, balance unexpended	452.78
July 1, 1898, outstanding liabilities	10.00
July 1, 1898, balance available	442.78
Amount (estimated) required for completion of existing project	25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix P 8.)

9. *Sarasota Bay, Florida.*—The approved project upon which work has heretofore been done contemplated the formation of a continuous channel 100 feet wide and 5 feet deep at mean low water from Tampa Bay to the town of Sarasota, Fla., a distance of 21¼ miles, the estimated cost for this stretch being $17,500.

The act of Congress of June 3, 1896, appropriated $2,500 for improving Sarasota Bay from Tampa Bay to Caseys Pass, while heretofore the improvement was only for Sarasota Bay "from Tampa Bay to Sarasota, Fla." The survey of 1889 was made, as directed, from Tampa Bay to Caseys Pass, and an estimate was presented amounting to $37,500 for securing a channel 75 feet wide and 3 feet deep at mean low water through the obstructing shoals below Sarasota. Under the act of June 3, 1896, the latter project is included in the improvement, so that the total estimate of cost is now $55,000.

Previous to any attempt at improvement there was a navigable channel with a minimum depth of 5 feet extending throughout the length

of Big Sarasota Bay, excepting in two reaches, Palma Sola Pass and Long Bar, which have a total length of 5,400 feet. In these reaches the available depth was 4.3 and 3.5 feet, respectively. The tidal range in the bay is 1.5 feet.

Between Sarasota and Caseys Pass, at the south end of the bay, the available channel depth was 1.2 feet at mean low water, except through the Mangroves, where it was nothing.

The work so far accomplished has resulted in the formation of a channel 50 feet wide and 5 feet deep from Tampa Bay to Sarasota. This is the depth but not the width required by the project. A channel has been cut 1,460 feet into the shoal at the Mangroves. This has resulted in no benefit, as the rest of the shoal is bare in places at low water.

The improvement so far effected has resulted in cheapening the cost of transportation between Sarasota and points north.

The maximum draft that can be carried at low water is 5 feet to Sarasota, nothing to Caseys Pass.

The amount expended to June 30, 1897, was $9,998.43.

The commercial statistics for this bay have been incomplete. The adjacent country is still undeveloped, and its development depends largely on the navigability of the bay. All trade is carried on by water, and the improvement effected has given a safe passage at all times for small vessels.

The commerce consists of cattle, fertilizers, agricultural products, lumber, and general merchandise.

July 1, 1897, balance unexpended	$2,501.57
June 30, 1898, amount expended during fiscal year	1,930.03
July 1, 1898, balance unexpended	571.54
Amount (estimated) required for completion of existing project	42,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix P 9.)

10. Manatee River, Florida.—For 12 miles from its mouth in Tampa Bay this river has the characteristics of an estuary. Previous to improvement in the estuary the general depth of the river varied from 7 to 20 feet. At the mouth there was a long shoal with a depth of 7 feet. Between Palmetto and Braidentown there was another bar covered by from 3 to 5 feet of water.

An examination of the river with a view to its improvement was made in 1881, and a project adopted in 1882 which contemplated forming a channel 100 feet wide and 13 feet deep from Tampa Bay to Shaw and McNeils points. In 1887 the project was modified to cover the river as far up as Manatee and give a depth of 9 feet at mean low water. This channel was completed, and in 1890 the original project was again adopted.

Under the terms of the river and harbor act of June 3, 1896, which provided that $3,000, or so much thereof as necessary, of the funds appropriated for improving this river should be used in improving the cut-off into Terraceia Bay, a project for making a channel through the cut-off 100 feet wide and 6 feet deep was submitted, and approved on June 23, 1897. It was estimated that this channel would cost $20,000. Previous to improvement there was a channel through this cut-off, for rowboats only, of 1 foot at mean low water.

In 1883–84 a cut was made to a depth of 12.5 feet across the bar at

the mouth of the river. This has since entirely disappeared. During and prior to 1890 a channel 150 feet wide and 8 feet deep was dredged through the shoal between Manatee and Braidentown. In 1893 a channel was dredged through the shoal at Sneads Point 81 feet wide and 12 feet deep; and in 1896 this channel was extended and widened, so that it is now 100 feet wide and 12 feet deep.

During this fiscal year a channel was cut through the cut-off into Terraceia Bay 50 feet wide, 4.5 feet deep, and 2,840 feet long. This channel allows small craft to pass to and from Manatee River and Terraceia Bay, but it is not wide and deep enough to permit the passage of some steamers which ply regularly between Tampa and the Manatee River. The continuation of this improvement is desirable.

The amount expended to June 30, 1897, was $43,167.19, which includes $482.75 for the cut-off into Terraceia Bay.

To do the work required on the bar at the mouth of the river in an economical and effective manner the full amount of the balance of funds required to complete the project, $29,000, should be made available before it is commenced.

Likewise, the balance required to complete the improvement of the cut-off, $17,000, should also be made available.

The improvement of this river has resulted in a steady increase in commerce, which, for this section, is carried on entirely by water. The statistics show an increase in the value of exports and imports from $816,326 in 1892 to $2,826,444 in 1896; during the same period the arrivals and departures of regular steamers increased from 900 to 1,200.

A draft of 9 feet can be carried from Tampa Bay through the mouth of the river to Manatee; through Terraceia Cut-off, 4 feet.

The commerce of the locality consists of agricultural products, fertilizers, lumber, and general merchandise.

The increase in tonnage due to improvement of this stream for several years past is shown by the following statement:

	Tons.		Tons.
1893	6,872	1895	11,718
1894	11,552	1896	21,000

July 1, 1897, balance unexpended	$3,832.81
June 30, 1898, amount expended during fiscal year	3,682.91
July 1, 1898, balance unexpended	149.90
Amount (estimated) required for completion of existing project	29,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix P 10.)

11. Withlacoochee River, Florida.—The project for the improvement of this river calls for the removal of snags, overhanging trees, and loose rocks, and the deepening of some of the worst shoals and a bar at the mouth, so as to form a channel having an available depth of 2 feet during about half the year from the mouth in the Gulf of Mexico to Pemberton Ferry, a distance of 77 miles.

The amount expended to June 30, 1897, was $23,914.88.

The entire river has been gone over from the mouth to Pemberton Ferry and the worst obstructions removed. The work was done partly by hired labor and partly by contract. The project is practically completed, although there are still obstructions to be removed before navigation can be considered safe.

The improvement has not resulted in any marked benefit, owing to the fact that the period during which navigation is open does not correspond with the season during which it is necessary to move the products of the region.

Large deposits of phosphate have been discovered in the valley of the river since the original project was formed, and the only means of transporting the product of the mines at present is supplied by the railroads. The cost of this transportation to the nearest seaport amounts to about one-half the value of the phosphate on board ship.

A survey of this river was completed in May, 1897, and the report thereon, with plans and estimates for a new project, was printed in House Doc. No. 199, Fifty-fifth Congress, second session; also submitted herewith as Appendix P 18.

The maximum draft that can be carried is 2 feet during one-half of the year.

July 1, 1897, balance unexpended	$785.12
July 1, 1898, balance unexpended	785.12

(See Appendix P 11.)

12. Suwanee River, Florida.—The project for the improvement of the Suwanee River was adopted in 1879. The reach of the river covered by the project extended from Ellaville to its mouth in the Gulf of Mexico, a distance of 130 miles. At that time the obstructions in this portion of the river consisted of shoals composed of soft, unstratified limestone mixed with flint, extending partly or entirely across the river, in some instances covered with shallow deposits of sand and in others bare; also snags and overhanging trees. The channels across these shoals were often narrow and very crooked. Their depth at mean low water would vary from 15 inches to 3 feet. At places, large isolated limestone bowlders in the channel were constant sources of danger to navigation.

An examination of the river with a view to its improvement was made in 1879. The estimated cost of the work to be done was $55,158.

The proposed improvement consists in deepening the bar at the passes by dredging, the removal of snags and overhanging trees along the river, and deepening and improving the channel at various places by the removal of rocks and snags and construction of wing dams, so as to straighten, widen, and deepen the channel. The depth to be obtained is 5 feet through the bars at the passes for a width of 150 feet and up the river as far as New Branford, a distance of 80 miles. From there to Ellaville, a distance of 50 miles, the depth is to be 4 feet and the width 60 feet.

The aggregate amount of the appropriations for this work is $50,000. Of this $10,000 was authorized to be expended in the purchase or construction of a snag boat, with dredging and other machinery.

With this amount a boat was built, and it was placed in commission in April, 1889, since which time it has been in almost constant service on the rivers and harbors in Florida. While it has served its purpose admirably, considering its low cost and the hard duty it has performed, it is now old and is expensive to keep in repair. A new, larger, and more seaworthy boat is urgently needed to take its place.

The appropriation of $3,000 made by the river and harbor act of June 3, 1896, has been expended the past fiscal year in dredging and blasting on the Fort McComb and Lower Double Island Shoal, making a channel 4 feet deep at low water.

The maximum draft that can be carried at low water is 5 feet from the Gulf to New Branford and 3 feet from there to Hudson, 10 miles *below Ellaville.*

The amount expended to June 30, 1897, was $46,502.73.

The improvement of the river has resulted in a steady increase in commerce since 1890. In that year the total value of imports and exports amounted to $1,234,000, while in 1896 the value was $1,470,470. The tonnage in the same period increased from 27,416 to 34,474. Seventy-five per cent of the commerce of the neighborhood is carried on the river.

July 1, 1897, balance unexpended	$3,497.27
June 30, 1898, amount expended during fiscal year	3,413.13
July 1, 1898, balance unexpended	84.14
Amount (estimated) required for completion of existing project	15,158.00
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	8,000.00

(See Appendix P 12.)

13. Removing sunken vessels or craft obstructing or endangering navigation.—In 1896 the removal of nine wrecks that had been reported as liable to endanger navigation in Man of War Harbor, Key West, Fla., was authorized by the Secretary of War. After due advertisement, bids were opened for the removal of these wrecks August 20, 1896, and the contract was awarded to the lowest bidder. The amount bid was $11,340, and the contract was entered into September 18, 1896. The contract price was subsequently reduced to $10,240, as the owner of one of the obstructions desired to remove it himself. Actual work began October 13, 1896, and by January 23, 1897, all of the obstructions specified had been removed. During the removal of these wrecks seven others were discovered in the vicinity, and it was decided to remove them and also the wreck of the *Governor Marvin*, lying nearer to the entrance to Key West Harbor. After due advertisement, bids for the removal of these additional wrecks were opened April 24, 1897, and contract was entered into May 11, 1897, the price being $6,750. Work under this contract began June 21, 1897, and was completed July 31, 1897. Altogether sixteen wrecks were removed by these operations. The total cost of the work was $19,457.65.

(See Appendix P 13.)

SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896, AND RESOLUTIONS OF CONGRESS OF MAY 6 AND 7, 1898.

The surveys of the following localities, required by the river and harbor act of June 3, 1896, and resolutions of Congress of May 6 and 7, 1898, were made by the local officer, Lieut. Col. W. H. H. Benyaurd, Corps of Engineers, and reports thereon submitted:

1. Report upon condition of St. Johns River, Florida, at Orange Mills Flats, below Palatka, with reference to navigation for ocean-going craft, together with estimate of the cost of improvement.—May 30, 1898, Lieutenant-Colonel Benyaurd submitted report required by concurrent resolution of Congress, passed by the House of Representatives May 5, 1898, and concurred in by the Senate May 6, 1898, requesting the Secretary of War to—

furnish Congress with information as to the condition of the St. Johns River in the State of Florida, at the point known as Orange Mills Flats, below the city of Palatka, as the river runs, with reference to navigation for ocean-going craft, and what sum of money will probably be required to put said river at that point in condition for navigation for coastwise craft such as usually enter the said river, and whether or not the expenditure necessary for said purpose will be justified by the traffic above said point.

Colonel Benyaurd states that to improve the shoal at Orange Mills Flats alone for seagoing craft that would reach Jacksonville with intent of making Palatka would be useless unless the channel depths below be likewise improved, and he presents a project which contemplates a channel depth of 13 feet at mean low water.

He estimates the cost of a channel 200 feet wide and 13 feet deep at mean low water between Jacksonville and Palatka to be $120,000, and states that in his opinion the commercial interests of the St. Johns River warrant the improvement of the river over the stretch in question.

The report was transmitted to Congress and printed in House Doc. No. 523, Fifty-fifth Congress, second session. (See also Appendix P 14.)

2. Survey of St. Lucia Inlet and River, Florida.—Lieutenant-Colonel Benyaurd submitted report of survey June 15, 1898.

The St. Lucia River empties into the Indian River opposite St. Lucia Inlet, and at the town of Stuart, 7 miles from its mouth, it divides into two branches, known as the Northwest Branch and South Branch. There is already an available channel depth of 11 feet at mean low water from the mouth to Stuart, with widths varying from 1,200 feet to 6,000 feet, and Colonel Benyaurd states that it will never be necessary to carry any improvement farther up the river than Stuart, where the Florida East Coast Railway crosses. He therefore suggests no improvement of the river.

St. Lucia Inlet is considered as extending from the mouth of the St. Lucia River to the ocean, and has through it an available channel depth of 6 feet at mean low water. The depth across the bar is between 6 and 7 feet and that on the shoal between deep water inside the bar and deep water in the river is 6 feet. Colonel Benyaurd is of opinion that any improvement of the inlet should begin at the bar, and that the first work to be undertaken is the construction of a breakwater to intercept the waves approaching from the northeast, this work to be followed by dredging. The construction of this breakwater as far as the 18-foot contour will, it is estimated, cost $347,000, and if extended to the 24-foot contour its cost will be about $729,000.

The estimates for dredging proposed are based on propositions to secure a channel 300 feet wide on bar and 200 feet wide inside the inlet, with depths of 8 feet, 10 feet, and 12 feet at mean low water, and are as follows:

Channel 8 feet deep	$24,600
Channel 10 feet deep	230,600
Channel 12 feet deep	484,000

The annual cost of maintenance will be about $2,000 for dredging and $3,000 for repair of breakwater.

These estimates are made on the assumption that the entire amounts will be appropriated in one sum, and Colonel Benyaurd states as his opinion that the expenditure of a moderate sum on the improvement of the inlet seems to be justified, and that the improvement is worthy of being undertaken by the General Government.

The report was transmitted to Congress and printed in House Doc. No. 548, Fifty-fifth Congress, second session. (See also Appendix P 15.)

3. Plan and estimate for improving Hillsboro Bay, Florida, from its confluence with Tampa Bay, through Hillsboro Bay and River, to the city of Tampa.—June 3, 1898, Lieutenant-Colonel Benyaurd submitted plan and estimate for the improvement of Hillsboro Bay, Florida, from its confluence with Tampa Bay, through Hillsboro Bay and River, to the city of Tampa, called for by joint resolution of Congress approved May 7, 1898.

The first appropriation made by Congress for work at this locality was contained in the river and harbor act approved June 14, 1880, and was for "improving Tampa Bay, Florida, deepening the bar and channel from the bar to the town of Tampa, ten thousand dollars." When this appropriation became available two plans of improvement were considered, one providing for securing a straight channel from a point near the mouth of the river along the shortest distance to deep water in the bay, and the other contemplating deepening the present channel; but from motives of economy, and with a desire for early results, the money was applied to dredging the present channel, and an aggregate of $80,000 has been expended upon this work.

The plan now submitted contemplates securing a channel in Hillsboro River from a point about 100 feet south of the bridge crossing the river at Lafayette street to the mouth of the river, and from there along the line of shortest distance to the 12-foot contour in Hillsboro Bay; this channel to be 12 feet deep at mean low water, 200 feet wide in the river, and 150 feet wide in the bay. The work proposed is estimated to cost $300,000, with $1,000 annually for maintenance, and Colonel Benyaurd expresses the opinion that this expenditure is no greater than is commensurate with the interests involved.

The views of Colonel Benyaurd are concurred in by the Chief of Engineers.

The report was transmitted to Congress and printed in House Doc. No. 545, Fifty-fifth Congress, second session. (See also Appendix P 16.)

4. *Survey of Anclote River, Florida.*—Lieutenant-Colonel Benyaurd submitted report of survey December 27, 1897.

The project presented by Colonel Benyaurd contemplates securing a channel 100 feet wide and 6 feet deep at mean low water from Anclote Anchorage to Sponge Harbor, and thence 4 feet deep at mean low water to the county bridge at Tarpon Springs. The cost, he estimates, will be $51,500, and he expresses the opinion that the improvement is well worthy of being undertaken.

The report was transmitted to Congress and printed in House Doc. No. 200, Fifty-fifth Congress, second session. (See also Appendix P 17.)

5. *Survey of Withlacoochee River, Florida, from its mouth to the head of navigation.*—Lieutenant-Colonel Benyaurd submitted report of survey December 20, 1897.

The river and harbor act of August 18, 1894, contained an appropriation of $800 for Withlacoochee River, to be applied to maintenance, including a survey of the mouth of the river. In the Report of the Chief of Engineers for 1895 he states in regard to this item:

> This amount, being entirely inadequate to defray the expenses of a survey which is assumed to have for its object the collection of data on which to base an estimate of the cost of improving the mouth of the river, has not yet been expended.

The next river and harbor act passed by Congress (act of June 3, 1896) provided for a survey of "Withlacoochee River from its mouth to the head of navigation," and the survey under the terms of the last-mentioned act includes the locality required to be surveyed under the provisions of the act of 1894.

Colonel Benyaurd estimates that it will cost $120,000 to secure at the mouth of the river a channel 100 feet wide and 6 feet deep at mean low water, and this, he states, would permit vessels of 5 feet draft to ascend the river to a point 12 miles above its mouth; thence a railroad about 15 miles in length would reach the main body of the phosphate deposits, and there seems to be no question, so he reports, that this railroad would be built at once if the entrance to the river were improved. He

considers the river worthy of improvement to the extent and at the estimated cost stated.

A study of the character of the stream indicates that the only feasible method of making the river navigable to the vicinity of the phosphate mines is the construction of a system of locks and movable dams, at an estimated cost of $423,495.65, but their construction at the present time is not recommended.

Should the future development of commerce on the river warrant so large an expenditure as would be required for the establishment of a system of slack-water navigation, the question of the construction of locks and dams can then be considered.

The report was transmitted to Congress and printed in House Doc. No. 199, Fifty-fifth Congress, second session. (See also Appendix P 18.)

Lieutenant-Colonel Benyaurd was also charged with the duty of making a survey of *Tampa Bay, Florida, from Port Tampa to its mouth*, and report of the results will be duly submitted when received.

IMPROVEMENT OF HARBOR AT KEY WEST, FLA., AND ENTRANCE THERETO.

This work was in the charge of Lieut. Col. W. H. H. Benyaurd, Corps of Engineers, to February 1, 1898, and of Capt. Charles H. McKinstry, Corps of Engineers, since that date, with Capt. Robert P. Johnston, U. S. Volunteers, first lieutenant, Corps of Engineers, under his immediate orders to June 19, 1898. Division Engineer, Brig. Gen. Peter C. Hains, U. S. Volunteers, colonel, Corps of Engineers.

In 1882 an appropriation of $25,000 was made for dredging a channel through the bar at the northerly entrance, over a width of 300 feet and to a depth of 17 feet at mean low water. As was anticipated, the improvement effected was only temporary.

The project now in course of execution contemplates gaining a depth of 17 feet at low water by the construction of a jetty on the northeast side of the passage or entrance, supplemented by one on the west side and, if necessary, by dredging the bar.

Previous to the inception of this project the surveys showed a channel depth over the bar of 10.5 feet at mean low water.

With the appropriations made prior to that of June 3, 1896, aggregating $220,000, a jetty has been constructed on the northeasterly side of the entrance 11,354 feet in length. Of this 3,950 feet, measured from the outer end, has been built to the height of mean low water. The remaining portion of the jetty is at an average depth of 4½ feet below mean low water.

With the appropriation of $80,000 made in the act of June 3, 1896, it was decided to begin the construction of the west jetty. In order to determine the best location for this jetty an extended series of borings to rock was required. The survey was completed in February, 1897. Bids for doing the work by contract were opened June 4, 1897, and the contract was awarded to the lowest bidder.

The first scow load of stone under the present contract was deposited on the west jetty December 30, 1897. On June 2 work under the contract was suspended by the Secretary of War, at the request of the contractor, until hostilities with Spain should cease. A total of 14,980.1 tons of stone was placed under this contract.

Soundings taken on the bar June 6 and 7 indicate that the crest of the bar has moved to the westward (seaward) about 200 feet. The channel across the bar has a minimum depth of 12 feet.

The amount expended from 1888 up to June 30, 1897, was $224,822.26.

The estimate presented by the Board appointed to consider the proj-

ect for this improvement was for the construction of the east jetty and amounted to $500,000, although the Board foresaw the probable necessity for the construction of a west jetty. Authority has been given for the commencement of construction of the west jetty, but no increase in the estimate has as yet been authorized.

The character of the commerce affected by this improvement is somewhat varied and complicated. If the improvement were completed the channel would be used by all steamships plying to the Gulf ports, especially when westward bound. The improvement already effected has given a safe channel over the northwest bar for light-draft steamers at all times.

The commerce of Key West itself has decreased since 1892, owing to the removal of several cigar factories. The amount of freight carried through the northwest channel has, on the other hand, increased 50 per cent. This freight consists of agricultural products, cattle, lumber, sponges, cigars, tobacco, ship stores, and general merchandise.

July 1, 1897, balance unexpended		$75,177.74
June 30, 1898, amount expended during fiscal year		24,583.79
July 1, 1898, balance unexpended		50,593.95
July 1, 1898, outstanding liabilities	$275.00	
July 1, 1898, amount covered by uncompleted contracts	42,172.34	
		42,447.34
July 1, 1898, balance available		8,146.61

Amount (estimated) required for completion of existing project	225,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix Q.)

IMPROVEMENT OF RIVERS AND HARBORS IN WESTERN GEORGIA AND FLORIDA AND IN EASTERN ALABAMA.

This district was in the charge of Maj. F. A. Mahan, Corps of Engineers, having under his immediate orders Lieut. J. P. Jervey, Corps of Engineers. Division Engineer, Brig. Gen. Peter C. Hains, U. S. Volunteers, colonel, Corps of Engineers.

1. Carrabelle Bar and Harbor, Florida.—Carrabelle is situated on the Gulf coast of Florida, about 20 miles east of Apalachicola, at the mouth of Carrabelle or Crooked River, which constitutes the inner harbor and has a channel along the water front varying in depth from 9 to 15 feet, with a width of 100 feet.

A bar 1 mile wide between the 10-foot contours, having a depth at low tide of from 3 to 4 feet, obstructs the entrance from the river into St. Georges Sound.

The river and harbor act of June 3, 1896, adopted a project for improvement and appropriated $10,000 to be used in making a 10-foot channel from the mouth of Carrabelle River to the channel in the bay.

No estimate of the cost of this improvement has been submitted.

Under a contract dated June 11, 1897, a cut was made through the bar separating Crooked River from St. Georges Sound. This cut is 1,050 feet long, 53 feet wide, and 10 feet deep. The work was finished on August 7, 1897. An examination of the cut made in May, 1898, showed that the depth had been maintained and that, apparently, it had deepened slightly. To fully accomplish the apparent wishes of Congress the dredging should be continued to the deep water in the river above the wharves and the cut should be widened to 100 feet.

The value of the commerce of this place was reported in 1895 to be about $600,000 a year. As all vessels trading with Carrabelle have to enter and clear in the custom-house at Apalachicola, Fla., it is impossible to separate the commercial statistics from those of Apalachicola.

The expenditures to June 30, 1897, amounted to $207.54.

July 1, 1897, balance unexpended	$9,792.46
June 30, 1898, amount expended during fiscal year	9,792.46
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	10,000.00

(See Appendix R 1.)

2. *Apalachicola Bay, Florida.*—When the first survey of the bar at the mouth of the Apalachicola River was made, in 1878, the depth of water across it was 3.5 feet; the channel was narrow and tortuous and unavailable for commerce. The width of the bar between the 8-foot curves inside and outside varies. It averages 7,000 feet in round numbers.

The project of the improvement, adopted in 1879, provides for a channel 11 feet deep and 100 feet wide, this width to be increased to 200 feet if the results of the first cut should be such as to warrant the enlargement.

This project was amended in 1891 to include cutting a straight channel through Bulkhead Shoal (the ridge which separates Apalachicola Bay from St. Georges Sound on the east) 9 feet deep and at least 100 feet wide.

Since 1880 the amount expended on Apalachicola Bay up to June 30, 1897, was $143,192.53.

The condition of the improvement on June 30, 1897, was as follows: The channel across Bulkhead Shoal was in good condition. The cut through the bar at the mouth of the river, which had just been finished, was 5,500 feet long and 50 feet wide, with a low-water depth of 8 feet.

No work was done during the year just passed, no funds being available for the purpose. The expenditures of the year were for work done the previous year. The channel has shoaled 2 feet.

The original project for the channel through the bar at the mouth of the Apalachicola River has never been realized, and so long as dependence is placed on dredging alone satisfactory results can not be assured, and the maintenance of the channel in its present condition will require an annual expenditure of not less than $10,000.

Under the provisions of the river and harbor act of June 3, 1896, a survey was made of Apalachicola Bay and approaches to Apalachicola, with a view to obtaining a channel 100 feet wide and 18 feet deep at low water. The report on this survey is printed as House Doc. No. 129, Fifty-fourth Congress, second session, and on page 1655 et seq. of the Annual Report of the Chief of Engineers for 1897. The cost of the work was estimated to be $350,000 and about $30,000 per year for maintenance.

July 1, 1897, balance unexpended	$10,807.47
June 30, 1898, amount expended during fiscal year	10,425.00
July 1, 1898, balance unexpended	382.47
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	10,000.00

(See Appendix R 2.)

3. Apalachicola River, the Cut-off, and lower Chipola River, Florida.—The channel of the Apalachicola River was 6 feet deep throughout its entire length of 105 miles. It was greatly obstructed by logs and snags brought into it by its tributaries, the Chattahoochee and Flint rivers.

Piles had been driven across the channel at Moccasin Slough by the Confederate authorities during the civil war. Drift catching on these piles formed a dam. The water, prevented from following its old channel, cut a new one, very narrow and crooked, to the River Styx. Navigation was difficult at the Elbows on account of the abrupt bends. The original project was to obtain a channel 100 feet wide and 6 feet deep, at an estimated cost of $80,333.

This project was amended in 1890 by adding to it the securing of a channel 60 feet wide and 5 feet deep through the Cut-off and lower Chipola River.

Since 1874 there had been expended on this stream to June 30, 1897, the sum of $58,047.12.

The funds expended during the year ending June 30, 1898, were applied to snagging and to the repairs of the snag boat.

The appropriation made for this stream by the river and harbor act of 1896 was not sufficient to do any work in straightening the river at Moccasin Slough, the Elbows, the Cut-off, and lower Chipola River.

The river and the Cut-off are in fair navigable condition, except for a few scattered logs which will cause trouble at extreme low water. The crooked and narrow channel through Lee Slough is completely blocked for steamboats by drift saw logs, many of them 3 feet and more in diameter at the larger end, dropped from rafts by the carelessness of lumbermen.

The commerce of this river is so combined with that of the Chattahoochee and Flint rivers that a separation is impossible. The commerce of these streams amounts to about $2,000,000 a year.

July 1, 1897, balance unexpended	$1,452.88
June 30, 1898, amount expended during fiscal year	978.78
July 1, 1898, balance unexpended	474.10
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	6,000.00

(See Appendix R 3.)

4. Flint River, Georgia.—This river was navigable only from its mouth to Bainbridge, Ga. The channel was narrow, crooked, and much obstructed by logs, snags, and overhanging trees. There was no navigation above Bainbridge except under very favorable conditions.

The original project called for a channel 100 feet wide and 3 feet deep at extreme low water from the mouth of the river to Albany, Ga., at a cost of $184,862. The distance is 105 miles.

This project was amended in 1879 so as to include giving a channel for light-draft steamers from Albany to Montezuma, 77 miles, by the removal of logs, snags, and overhanging trees, at a cost of $15,100.

The amount expended on this river to June 30, 1897, is $202,081.10.

The river is navigable at all seasons from its mouth to Bainbridge, a distance of 30 miles. From Bainbridge to Sisters Islands, 39 miles, navigation is impossible at low water on account of rocks. From Kennedy Shoals to Albany, 36¼ miles, the channel has been cut gradually, a little every year, through the rock, so that this stretch is navigable all the year.

No work was done during the year just passed. The plant was too much decayed by service for further use and the funds on hand were insufficient to renew it. The expenditures during the year were for services of watchman and some necessary repairs to plant, etc.

The commerce of this stream is one with that of the Apalachicola and Chattahoochee, being all carried on by the same boats.

The freight carried is of miscellaneous character. The largest half dozen items in weight were provisions, naval stores, cotton, grain, fertilizers, and miscellaneous freight. Its total value for all three streams is about $2,000,000 a year. To this must be added the value of large quantities of timber rafted, for which no figures can be had, as no records are kept.

July 1, 1897, balance unexpended	$3,918.90
June 30, 1898, amount expended during fiscal year	1,346.10
July 1, 1898, balance unexpended	2,572.80
July 1, 1898, outstanding liabilities	19.95
July 1, 1898, balance available	2,552.85
Amount that can be profitably expended in fiscal year ending June 30, 1900, for construction of plant and maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	15,000.00

(See Appendix R 4.)

5. *Chattahoochee River, Georgia and Alabama.*—(*a*) *Below Columbus.*—This river is not navigable above Columbus, Ga. It was originally much obstructed from Columbus to its junction with the Flint, 224 miles, by logs, snags, and overhanging trees, and by a number of rock and marl shoals. Navigation was difficult and dangerous by day and impossible by night.

The present project for improvement provides for a low-water channel 100 feet wide and 4 feet deep from Columbus, Ga., to Chattahoochee, Fla., 224 miles, to be obtained by removing logs and snags from the channel and overhanging trees from the banks, by cutting through rock shoals and scouring out sand bars by means of works of contraction and shore protection.

The estimated cost of this work from Chattahoochee to Eufaula, Ala., 139 miles, is given as $145,247. No estimate can be found for the part of the river between Eufaula and Columbus.

The amount expended on this river to June 30, 1897, was $297,464.09. The channel below Eufaula is nearly clear of obstructions, and boats drawing 3½ feet have little trouble in navigating the river.

There are still some bars and isolated obstructions which require removal. These are at St. Francis Bend, Rock Island, King Rock, and at other points where less work is needed. Much is needed in the way of repairs to the works at Hospital Reach, Upatoie, and Shell Creek.

The channel cut through marl reefs at Uchee, Culpeper, and Kowikee shoals and through the rock reef at Hardridges and Widow Browns shoals is still clear.

The annual accumulation of logs and snags is scattered over the length of the river and makes low-water navigation dangerous.

The funds expended during the year ending June 30, 1898, were applied to snagging and opening the channel.

The commerce of the stream is as stated under the Flint River.

The work on the Apalachicola, Flint, and Chattahoochee rivers is costly by reason of there being no proper working plant for dredging

or rock removal. The three rivers form one system and one plant could operate on all. A dredge and scows would cost $15,000. This cost would be saved in three seasons' work.

July 1, 1897, balance unexpended	$12,535.91
June 30, 1898, amount expended during fiscal year	11,929.01
July 1, 1898, balance unexpended	606.90
July 1, 1898, outstanding liabilities	60.10
July 1, 1898, balance available	546.80
Amount that can be profitably expended in fiscal year ending June 30, 1900, for construction of plant and maintenance of improvement	17,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, for repairs and new work	32,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(*b*) *Between Westpoint and Franklin.*—This section of the river is 38 miles long. In its original condition there was a series of pools, varying in length from half a mile to 5 or 6 miles, separated by rock shoals and rapids, at some of which the fall is as great as 8 feet in a mile. The channel in the pools is nowhere less than 4 feet deep and is from 300 to 500 feet wide. It is much wider on the shoals, and its depth is frequently not more than a few inches. It was not available at all for commerce before improvement was begun.

The river and harbor acts of 1892, 1894, and 1896 each provided that $5,000 of the sum appropriated for the Chattahoochee River should be spent on this section.

The project for the expenditure of this sum was "to remove the lesser rock shoals, sand and gravel bars by excavation and works of contraction; to remove overhanging trees from the banks, and snags, logs, and other obstructions from the channel, and to overcome the more serious obstructions by the construction of locks and dams; to give a minimum depth of 3 feet at low water in the channel between Westpoint and Franklin, a distance of 38 miles."

There had been spent on this work to June 30, 1897, $9,630.84.

A low-water channel 50 feet wide and 3 feet deep had been obtained through Roberts, Flat-rock, and Haynes Island shoals.

A survey of the Chattahoochee River was provided for by the act of June 18, 1878, and a report on such survey was submitted by Maj. W. R. King, Corps of Engineers, and is printed in the Annual Report of the Chief of Engineers for 1880, page 1705 et seq. The estimated cost of work considered necessary at that time for improvement between Westpoint and Franklin was about $50,000.

A preliminary examination of the Chattahoochee River between Westpoint and Franklin was made in accordance with the requirements of the river and harbor act of September 19, 1890, and report thereon is printed as House Ex. Doc. No. 134, Fifty-first Congress, second session, and in the Annual Report of the Chief of Engineers for 1891, page 1756 et seq. Capt. Philip M. Price, Corps of Engineers, the officer who made this report, considered this section of the river worthy of improvement, and estimated the cost of the improvement to be approximately $100,000; he recommended that a survey be made, at a cost of $1,500, for the purpose of procuring data for a satisfactory estimate of cost, but the division engineer, Gen. C. B. Comstock, Corps of Engineers, did not approve the recommendation, and his opinion was concurred in by the then Chief of Engineers, General Casey, and no survey was ordered by Congress, the disapproval of the survey being based on the

relative approximate cost of improvement, $100,000, and the present and prospective commerce as it existed in 1890.

July 1, 1897, balance unexpended	$5,369.16
July 1, 1898, balance unexpended	5,369.16

(See Appendix R 5.)

6. Choctawhatchee River, Florida and Alabama.—Before the improvement of this stream was begun it was, notwithstanding its average width of 300 feet, almost totally obstructed by the accumulation of logs and snags. Navigation was only possible for flatboats and rafts. The channel was exceedingly dangerous, especially during the lower stages of water.

The project for improvement, adopted in 1880, provided for a low-water channel from the mouth of the river to Geneva, Ala., 125 miles, and a navigable high-water channel from Geneva to Newton, Ala., 37 miles.

This project was amended in 1890 so as to provide for a low-water channel from Geneva to Newton.

By the provisions of the river and harbor act of 1890 Congress required that a draw, approved by the Secretary of War, be placed in Hollis Bridge before any money might be spent above this bridge.

The improvement consists in removing logs and snags and trees from the channel and banks, in protecting the banks where necessary, and in cutting through rock and marl shoals and sand bars.

The expenditures on this river to June 30, 1897, were $142,238.23.

On June 30, 1897, the river from its mouth to Caryville was sufficiently clear to meet the requirements of the present commerce. There was a fairly navigable channel, except at extreme low water, from Caryville to Geneva, and a partly improved channel from Geneva to Pate Landing, a distance of 25 miles. Steamboats could run quite regularly between Geneva and the railroad crossing at Caryville. Boats carrying large amounts of freight had little trouble in running the river either by day or night.

As there were no funds available for work nothing was done during the year, the expenditures being for payment of watchman and for liabilities incurred last year, etc.

The commerce of this stream is mainly cotton, stores, logs, and timber. It was valued in 1880 at $1,740,500 and in 1898 at $2,400,000, an increase of $659,500.

July 1, 1897, balance unexpended	$1,638.39
June 30, 1898, amount expended during fiscal year	879.84
July 1, 1898, balance unexpended	758.55
July 1, 1898, outstanding liabilities	50.00
July 1, 1898, balance available	708.55
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement	3,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, for repairs and new work	7,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix R 6.)

7. Harbor of Pensacola, Fla.—The channel leading into Pensacola Bay was much obstructed by wrecks in 1878. A survey made in 1879 showed that the depth of water across the inner bar had been reduced to 19.5 feet at mean low water, a depth insufficient for the commerce of the port. The western shore of the gorge of the bay was cutting away

fast, and almost the whole of Fort McRee, which stood there, had been washed away.

The first project of the improvement considered only the removal of wrecks and the making of a survey to determine what more should be done. As a result of this survey a Board of Engineers recommended, in 1881, dredging across the inner bar a channel 300 feet wide and 24 feet deep at mean low water for the temporary relief of navigation and protecting the shore near Fort McRee from further washing.

This project was never carried out in its entirety. The greatest width ever obtained was but 225 feet; this in the autumn of 1893. The shore protection for the west bank was built in 1890. It consists of two jetties, one 360 and the other 220 feet long, made with a structure of riprap and a concrete coping. The shore line has been maintained.

In 1891 the project proposed the procurement of a channel across Caucus Shoal by means of two jetties, one starting from the east, the other from the west, side of the entrance, assisted by a certain amount of dredging, the estimated cost being $1,830,000.

In 1895 it was decided that dredging be tried before beginning the building of the jetties. The success attending the dredging was such that in 1896 it was decided to construct a dredge especially for this harbor and to dredge a channel 300 feet wide by 30 feet deep.

There had been expended at this harbor to June 30, 1897, $425,916.06.

The exact depth of the channel across the inner bar on June 30, 1897, is not known. It was, however, between 20 and 21 feet, with a width of little more than 100 feet.

Few vessels used the old channel across the inner bar during the year. Those which did were either in ballast or else of small size.

A good dredge can readily remove any filling that may take place in the channel through the Caucus Shoal.

Vessels drawing full 24 feet have passed through the new cut.

The funds expended during the past year have been devoted to preparing the designs of a dredge and to enlarging the cut through the Caucus Shoal.

Bids were asked for the construction of a dredge. These were opened on May 21, 1898. On account of war conditions only one bid was received. As the amount asked for the work was beyond the estimated price the bid was rejected, and arrangements were begun to continue the work by contract.

July 1, 1897, balance unexpended		$224,083.94
June 30, 1898, amount expended during fiscal year		65,263.94
July 1, 1898, balance unexpended		158,820.00
July 1, 1898, outstanding liabilities	$615.52	
July 1, 1898, amount covered by uncompleted contracts	18,868.67	
		19,484.19
July 1, 1898, balance available		139,335.81
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		70,000.00

(See Appendix R 7.)

8. Escambia and Conecuh rivers, Florida and Alabama.—The stream called the Escambia River in Florida is called the Conecuh in Alabama. It is one and the same stream.

This river is very important commercially, as the neighboring country supplies two-thirds of all the timber, which is the principal shipping

product of Pensacola. It was much obstructed originally by snags, sunken logs, and rock shoals and sand bars, and by a shallow bar at the mouth.

The project for improving the stream provides for the removal of snags, logs, and other sunken obstructions, for cutting through rock shoals, deepening sand bars, and dredging a channel through the bar at the mouth of the river in Escambia Bay.

There had been expended on these rivers to June 30, 1897, $91,666.67.

The condition of the stream June 30, 1896, was that rafts of timber or logs could pass safely at a 2-foot stage from a point 106 miles up the river to its mouth, but the bar at the mouth was impassable for tugs.

There being no funds available, no work was done during 1898. The money expended was for the services of a watchman, caring for public property, etc.

The fact that tugs can not cross the bar at the mouth of the stream causes frequently great loss of timber, which has to float across the bar unaided and tie up outside, where it can be reached by the tugs.

The commerce of this stream is mainly timber and lumber. It was valued in 1884 at $566,500 and in 1895 at $2,000,000, an increase of $1,433,500.

It is impossible to obtain any exact value of the commerce of this stream, as no official records are kept. It is known to be large—well beyond $2,000,000 a year, in all probability.

July 1, 1897, balance unexpended	$833.33
June 30, 1898, amount expended during fiscal year	612.71
July 1, 1898, balance unexpended	220.62
July 1, 1898, outstanding liabilities	44.50
July 1, 1898, balance available	176.12
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement	6,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, for dredging at the mouth	6,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix R 8.)

9. *Alabama River, Alabama.*—The river was so full of sunken logs and snags that many steamboats were lost by running on them. Navigation was difficult and dangerous by reason of the many bars, shoals, and reefs, on which the depth of water was only 2.5 to 3.5 feet. Boats could run only by daylight during low stages of the river. Long detentions at the bars were frequent.

The original project for the improvement, adopted in 1876, called for a depth of 4 feet at low water, increased in 1891 to 6 feet, from Wetumka, Ala., to the junction of the Alabama and Tombigbee rivers, an estimated distance of 323 miles. This depth was to be obtained by removing logs and snags from the channel and overhanging trees from the banks, by cutting through rock and gravel bars by blasting and dredging, and by deepening sand bars by means of works of contraction and shore protection.

Further study of the river since the project of 1891 was prepared shows that the attainment of the results expected by that project is impossible by the means proposed.

There had been spent on this river, inclusive of maintenance and snagging, to June 30, 1897, the sum of $336,636.37.

The condition of the river at this date was such that the stream was

navigated by night as well as by day between Montgomery and Mobile during ten months of the year. During the remaining two months the lack of depth of water on the bars between Montgomery and Selma prevented vessels from passing. The depth of water on several bars has been increased by 2 to 5.5 feet. The river was clear of logs and snags, except those which had fallen in during the high water of the preceding winter.

The autumns of 1896 and 1897 were periods of exceedingly low water. The river at Montgomery stood at 2.25 feet below the zero of the gauge and at Selma at 1.25 feet below. Boats were unable to come above Prairie Bluff, 188 miles above Mobile.

The stage of water during the present spring and summer is lower than ever known at these seasons. There is every indication that the autumn stage will be still lower than in 1896 or 1897.

The funds expended in 1898 cleared the river completely of all snags.

The commerce of the stream in 1878 was valued at $5,055,000 in round numbers; in 1898 it is valued at $8,400,000. It consists principally of cotton, naval stores, hides, staves, fertilizers, miscellaneous goods of all kinds, and large quantities of timber and lumber. As no record of the timber and lumber rafted is kept, the value thereof is not known.

July 1, 1897, balance unexpended	$8,363.63
June 30, 1898, amount expended during fiscal year	7,160.92
July 1, 1898, balance unexpended	1,202.71
July 1, 1898, outstanding liabilities	484.19
July 1, 1898, balance available	718.52
Amount (estimated) required for completion of existing project	246,251.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	75,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix R 9.)

10. Coosa River, Georgia and Alabama.—The Coosa River extends from Rome, Ga., where it is formed by the junction of the Oostenaula and Etowah rivers, to a point 18 miles above Montgomery, Ala., where it unites with the Tallapoosa River to form the Alabama. Its length is about 315 miles.

The river was available for navigation from Rome to Greensport, Ala., a distance of 162 miles, before any improvement was made. From Greensport to Wetumka, Ala., 142 miles, the bed of the stream is so much broken up with reefs and shoals of rock as to make its navigation practically impossible. Many years ago cotton was carried down the river to Mobile on flatboats at high water, but no boat ever came back.

The river is divided by legislative action into two parts—that lying between Rome and the East Tennessee, Virginia and Georgia Railroad Bridge and that lying between the bridge and Wetumka. The first is 236 miles long; the second is 68 miles.

(*a*) *Between Rome, Ga., and the East Tennessee, Virginia and Georgia Railroad Bridge.*—The original project for this part of the stream contemplated a channel 3 feet deep and 80 feet wide. The width and depth were changed below Lock No. 3 to 4 feet and 100 feet, respectively.

The channel was to be made by washing out sand bars and by cutting through rock reefs. Below Greensport locks and dams were to be built.

There had been spent on this part of the river to June 30, 1897, the sum of $923,714.50.

As the result of the expenditure of this sum the river has been made navigable from Rome, Ga., to Harts Ferry, Ala., about 1 mile below Lock No. 3, a total distance of 180 miles.

With the money spent during the year ending June 30, 1898, two-thirds of the floor of Lock No. 4 has been laid, together with the foundations of the lock walls; work has been done also at Horseleg Shoal, Shorters Island, Mays Bar, McCoys Island, and Box Shoal, giving somewhat better water.

The earliest record on file of the value of the freight carried is in 1888. It was then $1,242,244. The present value is $2,050,000. The freight is of a miscellaneous character.

July 1, 1897, balance unexpended	$39,985.50
June 30, 1898, amount expended during fiscal year	25,469.35
July 1, 1898, balance unexpended	14,516.15
July 1, 1898, outstanding liabilities	2,031.66
July 1, 1898, balance available	12,484.49
Amount (estimated) required for completion of existing project	800,133.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(*b*) *Between the East Tennessee, Virginia and Georgia Railroad Bridge and Wetumka.*—The condition of this part of the Coosa River before beginning improvements was such as to make navigation impossible. While there were many deep pools, the water on the rock reefs and shoals was not sufficient to float a vessel of any sort, and the fall at many of the reefs is too great for a vessel to surmount.

The present project of improvement contemplates canalizing the river by the construction of 23 locks and dams. A great deal of channel work has also to be done.

The sum of $364,169.21 had been spent on this improvement to June 30, 1897.

The walls of Lock No. 31 are finished and ready to receive the gates and machinery for moving them and the valves and their machinery for filling and emptying the lock.

The cofferdam has been removed and the space between the land wall and the river bank has been filled up.

The field work of the survey for Locks Nos. 9, 10, and 11 was completed so far as Nos. 9 and 10 are concerned, and the maps are nearly done.

The condition of this part of the Coosa River is such that the entire section must be improved from end to end and connections be made with the navigation above and below before any commerce can be developed. It is recommended that either the appropriations for this work be made large enough to insure its completion within a reasonable time or that the work be abandoned.

July 1, 1897, balance unexpended	$45,830.79
June 30, 1898, amount expended during fiscal year	10,765.51
July 1, 1898, balance unexpended	35,065.28
July 1, 1898, outstanding liabilities	213.56
July 1, 1898, balance available	34,851.72
Amount (estimated) required for completion of existing project	4,683,074.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	250,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix R 10.)

11. Operating and care of canals and other works of navigation on Coosa River, Georgia and Alabama.—The expenses of operating and care of Locks Nos. 1, 2, and 3 and the canal between Locks Nos. 2 and 3 during the fiscal year ending June 30, 1898, amounting to $2,281.98, exclusive of outstanding liabilities ($545.87) on June 30, 1898, have been paid from the permanent-indefinite appropriation provided by section 4, act of July 5, 1884.

(See Appendix R 11.)

PRELIMINARY EXAMINATION MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examination of *Chipola River, Florida, from Marianna to its connection with the Apalachicola River*, required by the river and harbor act of June 3, 1896, was made by the local engineer, Maj. F. A. Mahan, Corps of Engineers, and report thereon submitted November 11, 1897. A portion of this river known as the Cut-off has been under improvement by the United States since 1890, the existing project providing for a channel 60 feet wide and 5 feet deep. For reasons stated in his report, Major Mahan does not consider the locality worthy of improvement; and from the information now available it does not appear probable that the interests of navigation on this river above the Cut-off are sufficient to justify such an expenditure as would be necessary for furnishing an available channel at low water, which involves the reconstruction of the fixed bridges. But, inasmuch as the fact has been presented to the Chief of Engineers that a line of vessels for use on this portion of the Chipola River is now being built, such a survey as will determine the cost of work and permit a comparison between such cost and the value of improvement to commerce would appear proper. The report was transmitted to Congress and printed in House Doc. No. 101, Fifty-fifth Congress, second session. (See also Appendix R 12.)

IMPROVEMENT OF RIVERS AND HARBORS IN WESTERN ALABAMA AND EASTERN MISSISSIPPI AND OF BOGUE CHITTO, LOUISIANA.

This district was in the charge of Maj. Wm. T. Rossell, Corps of Engineers, having under his immediate orders Lieut. James B. Cavanaugh, Corps of Engineers. Division Engineer, Brig. Gen. Peter C. Hains, U. S. Volunteers, colonel, Corps of Engineers.

1. Mobile Harbor, Alabama.—This channel had originally a depth of 5½ feet through Choctaw Pass and 8 feet on Dog River Bar.

The original project was for a channel 10 feet deep at mean low water through Choctaw Pass and Dog River Bar.

From 1870 to 1878 the channel was deepened to 13 feet under a project submitted by Maj. C. B. Reese, Corps of Engineers, August 5, 1870, for a channel 300 feet wide and 13 feet deep at mean low water.

From 1881 to 1888 the channel was deepened to 17 feet under a project submitted by Lieut. Col. (then Capt.) A. N. Damrell, Corps of Engineers, for a channel 200 feet wide and 17 feet deep at mean low water, adopted in March, 1880. Before this project was completed a project was submitted by Lieutenant-Colonel (then Major) Damrell, and adopted in August, 1888, to dredge a channel of entrance from the Gulf of Mexico to the city of Mobile of 280 feet width on top of cut, with a central depth of 23 feet at mean low water.

Act of September 19, 1890, extended the work up Mobile River to the mouth of *Chickasabogue Creek* and increased the estimated cost

to $2,043,800, with entire length of channel 33.09 miles and the entire length of continuous cut of 32.27 miles. This work was placed under continuous contract by act of July 13, 1892.

Joint resolution of Congress approved March 16, 1896, revived the continuous contract and increased the amount by $160,000. Work under this resolution was suspended September 5, 1896.

Act of June 3, 1896, gave $60,000 for maintenance of the channel by dredging, and work was carried on under this appropriation until March 11, 1898.

Act of June 4, 1897, gave $25,000 for maintaining the channel, and under this appropriation the work continued without interruption from March 11, 1898, until June 21, 1898, when the funds were exhausted.

Since 1888 the total amount expended on this improvement to June 30, 1897, was $2,183,161.32.

On June 30, 1897, there was a channel of navigable width, with a depth varying from 20 to 23 feet at mean low water, but available throughout its length for vessels drawing 23 feet on account of the softness of the material which had filled in. Since that time further fills have caused the limit to which vessels can be safely loaded to be reduced to 22.5 feet.

All work done during the fiscal year ending June 30, 1898, has been dredging to maintain the channel and the removal of snags and deadheads by the U. S. S. *Maud.* It is estimated that $60,000 will be required for annual maintenance.

Comparative statement of lumber, cotton, etc., shipped to foreign and coastwise ports, from records of Cotton Exchange.

Articles.	1898.	1897.	1896.	1895.
	Tons.	*Tons.*	*Tons.*	*Tons.*
Lumber	76,079	106,095	88,045	83,557
Timber	97,765	191,772	129,021	144,787
Shingles	107	299	185	826
Staves	2,323	167	.....	.....
Cotton	86,550	76,847	52,090	29,941

July 1, 1897, balance unexpended	$55,638.68
June 30, 1898, amount expended during fiscal year	54,699.38
July 1, 1898, balance unexpended	939.30
July 1, 1898, outstanding liabilities	31.80
July 1, 1898, balance available	907.50
Amount (estimated) required for annual maintenance	60,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	60,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix S 1.)

2. Black Warrior River, Alabama.—The original condition of this river was such as to be practically closed to navigation on account of shoals at Tuscaloosa.

The name of "Black Warrior" is given to that portion of the Warrior River which lies above the city of Tuscaloosa, Ala.

The original project for the improvement of this river was approved in 1887, the object being to obtain a channel 6 feet deep by means of five locks and dams from Tuscaloosa to Daniels Creek, a distance of 15 miles, at an estimated cost of $741,670.

During the year ending June 30, 1896, three locks were completed.

In July, 1897, a telephone line was erected, connecting the United States Engineer Office with Locks Nos. 1, 2, and 3; and during the year the gauge at the proposed site of Lock No. 4 was read daily at 7 a. m. The expenditures for the year were chiefly in connection with survey for proposed waterway from Warrior River up Valley River to Birmingham and beyond to Five-mile Creek, the cost of which survey the act of June 4, 1897, provided should be paid from the appropriation for Black Warrior River.

The total amount expended on this improvement to June 30, 1897, was $583,747.76.

The present condition of the river is such that for 9 miles above Tuscaloosa there is a sufficient depth of water for coal barges.

July 1, 1897, balance unexpended	$20,002.24
June 30, 1898, amount expended during fiscal year	16,508.89
July 1, 1898, balance unexpended	3,493.35
July 1, 1898, outstanding liabilities	36.53
July 1, 1898, balance available	3,456.82
Amount (estimated) required for completion of existing project	190,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	75,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix S 2.)

3. Operation and care of locks and dams on Black Warrior River, Alabama.—These locks and dams are near Tuscaloosa, Ala., and are known as Locks Nos. 1, 2, and 3. They were finished and opened to commerce in November, 1895, and on July 1, 1896, their operation and care became a charge under the general law of July 5, 1884.

During the past year they have been operated without interruption by two lock hands at each lock, under the supervision of the lock master.

The commerce through the locks during the year 1898 amounted to 4,616 tons of coal, 5,728 tons of timber, 5,613 tons of building material, and 919 tons of miscellaneous freight.

(See Appendix S 3.)

4. Warrior and Tombigbee rivers, Alabama and Mississippi.—These rivers form the line of communication from the Warrior coal fields to tide water, and also for the products of the valley of the Tombigbee above Demopolis to Mobile.

(*a*) *Warrior River, Alabama.*—In its original condition this river was obstructed to such an extent by snags, logs, overhanging trees, etc., as to make navigation at low water impossible and dangerous during high water. The minimum width of the channel was 60 feet; the minimum depth 1 foot.

The original project for the improvement was to deepen the channel by jetty construction and to remove snags and overhanging trees so as to obtain for small boats a low-water channel 80 feet wide and 4 feet deep, at an estimated cost of $151,103.

The present project, adopted in 1890, is to obtain a channel 6 feet deep at ordinary low water throughout by removal of obstructions and building dams with gates, at an estimated cost of $557,000.

In 1891 a project for the construction of locks and dams was presented, the approximate cost of which, as estimated in 1897, is $1,320,000, but this project has not yet been formally approved. The action of Congress upon this project is necessary before operations under it can be commenced.

The total amount expended under the present project for this improvement to June 30, 1897, is $181,516.80.

During the past year seven bars have been opened and the channels protected by training walls.

A survey party, organized July 1, 1897, is now in the field making a careful examination of the river. High water interfered with their progress during the winter, but they have accurately surveyed and plotted 71 miles.

The present condition of this improvement is such that coal barges can be used on an 8-foot stage of water and ordinary packets on a 3-foot stage. Navigation is, however, generally limited to the months of January, February, March, and April.

Commercial statistics.

Articles.	1898.	1897.	1896.
	Tons.	*Tons.*	*Tons.*
Cotton	1,500	2,080	1,250
Grain	2,500	2,100	1,200
Iron	20	20	20
Lumber	60	50	50
General merchandise	2,000	1,300	1,200
Coal	4,616	2,000	500
Total	10,696	7,550	4,220

July 1, 1897, balance unexpended	$48,483.20
June 30, 1898, amount expended during fiscal year	40,761.46
July 1, 1898, balance unexpended	7,721.74
July 1, 1898, outstanding liabilities	389.52
July 1, 1898, balance available	7,332.22
Amount (estimated) required for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1900	250,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(*b*) *Tombigbee River, from its mouth to Demopolis, Ala.*—The original condition of the navigable channel of this portion of the river was such as to admit of steamboat navigation only during about six or eight months of the year, or during high water. The minimum width of the channel was about 100 feet, and the minimum depth 2 feet.

The project of 1879 was to afford a channel of navigable width and 4 feet deep at ordinary low water, from the mouth up to Demopolis, Ala., by removal of snags, logs, and overhanging trees, and the improvement of the worst bars.

The present project, adopted in 1890, is to secure a channel 6 feet deep at low water, by removal of logs, snags, and trees, and the construction of bank revetment and locks and dams.

In 1897 the plans for locks and dams were slightly modified, and the amount required to complete that portion of the improvement at that time was estimated to be $600,000.

The total amount expended on this improvement to June 30, 1897, was $246,528.53.

For present condition of lock and dam at McGrews Shoal, see Appendix S 4.

Commercial statistics.

Articles.	1898.	1897.	1896.
	Tons.	*Tons.*	*Tons.*
Cotton	16,250	7,800	8,350
Grain	.....	5,525	4,420
Iron	.....	95	92
Lumber	210,239	67,240	66,360
General merchandise	25,200	13,219	13,744
Coal	1,900	1,500	500
Total	253,589	95,379	93,466

July 1, 1897, balance unexpended	$83,471.47
June 30, 1898, amount expended during fiscal year	67,176.31
July 1, 1898, balance unexpended	16,295.16
July 1, 1898, outstanding liabilities	557.83
July 1, 1898, balance available	15,737.33

Amount (estimated) required for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1900	100,000.00
Submittted in compliance with reqirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(c) *Tombigbee River, from Demopolis, Ala., to Columbus, Miss.*—The original condition of this section of the river was such as to admit of navigation only during high water. The minimum width of the channel was about 70 feet and the minimum depth was 2 feet, but it was obstructed by snags, logs, overhanging trees, etc.

Up to 1890 all appropriations were made general for the Tombigbee River; on September 19, 1890, an appropriation of $15,000 was made for the section of Tombigbee River from Demopolis to Columbus.

The project of 1890 provided for obtaining a channel 6 feet deep at low water, by the removal of snags and other obstructions and the building of dams with gates.

A revision of the project for this work is desirable, but can not be presented until the will of Congress as to the extent of improvement is known. The estimate submitted is for maintenance by snagging only.

The total amount expended on this improvement to June 30, 1897, was $82,312.30.

The appropriations for the permanent improvement of this stretch of the river should be separated from that intended for snagging and temporary work.

The fall in this river from Columbus, Miss., to Demopolis, Ala., is 107.8 feet, and there will be required 10 locks and dams to give slackwater navigation. These will cost $2,000,000.

In its present condition light-draft boats can navigate this section of the river on a slight rise above ordinary low water.

July 1, 1897, balance unexpended	$67,687.70
June 30, 1898, amount expended during fiscal year	15,074.26
July 1, 1898, balance unexpended	52,613.44
July 1, 1898, outstanding liabilities	353.87
July 1, 1898, balance available	52,259.57

Amount (estimated) required for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(*d*) *Tombigbee River, from Fulton to Columbus, Miss.*—The original condition of this section of the river was such that navigation was impossible except during high water. The minimum width of the channel was 50 feet and the minimum depth 1 foot.

The project of 1873 was to obtain a good high-water channel, at an estimated cost of $35,000, and was completed in 1882, at a cost of $27,293.65. Since 1882 there had been expended in preservation of the improvement to June 30, 1897, $10,076.81.

The present condition of this section of the river allows of the free passage of rafts of logs and timber.

Commercial statistics.

Articles.	1898.	1897.	1896.
	Tons.	*Tons.*	*Tons.*
Pine, cypress, and oak logs	79,285	32,192	20,000

This includes the commerce from Walkers Bridge to Fulton.

July 1, 1897, balance unexpended	$7,923.19
June 30, 1898, amount expended during fiscal year	7,186.23
July 1, 1898, balance unexpended	736.96
July 1, 1898, outstanding liabilities	36.70
July 1, 1898, balance available	700.26
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	5,000.00

(*e*) *Tombigbee River, from Walkers Bridge to Fulton, Miss.*—The original condition of this section of the river was such that navigation for small rafts only was possible during high water, and then it was troublesome.

The project of 1888 was to obtain a good channel for navigation during high water by the removal of snags, logs, and overhanging trees, at an estimated cost of $11,000.

The total amount expended on this improvement to June 30, 1897, was $12,659.21.

The condition of this section of the river on June 30, 1898, is such as to allow large-sized rafts to be floated downstream on a 3-foot rise above ordinary low water.

The commercial statistics for this section of the river are included in those from Fulton to Columbus, Miss.

July 1, 1897, balance unexpended	$340.79
June 30, 1898, amount expended during fiscal year	5.00
July 1, 1898, balance unexpended	335.79
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	1,000.00

(See Appendix S 4.)

5. *Noxubee River, Mississippi.*—The original condition of this river was such that navigation was impossible except by small flats during four or five months of the year. The minimum width of the river was 60 feet and the minimum depth of the channel 1½ feet.

The project of 1880 was to afford a channel for small steamers from the mouth to Macon, Miss., of navigable width and depth when the water is above ordinary low stage, at an estimated cost of $65,245.25.

The total amount expended on this improvement to June 30, 1897, was $58,096.81.

This improvement was completed in 1889, and all work done since has been in preservation of improvement. No work was done and no expenses incurred during the fiscal year ending June 30, 1898.

There is no commerce on this river.

July 1, 1897, balance unexpended	$3,903.19
July 1, 1898, balance unexpended	3,903.19
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	3,000.00

(See Appendix S 5.)

6. *Pascagoula River, Mississippi.*—Before this improvement began the channel through the bar at the mouth of the river had a least depth of 3 feet. This was increased to 7½ feet, with a width of 180 feet, by dredging, from 1878 to 1880, at a cost of about $42,500. From the light-house near the mouth of the river there was a navigable channel obtained by removing snags and overhanging trees, from 1881 to 1884, at a cost of about $15,000.

In 1886 a project was adopted to obtain, by dredging, a channel of navigable width, with a minimum depth of 12 feet, from Moss Point down to the anchorage in the bay.

The condition of the river and of the improvement on June 30, 1897, was such as to allow vessels of 6½ feet draft to navigate up to Cedar Creek, a distance of 55 miles, all the year.

The present project is to maintain the river in its improved condition from Moss Point to the junction of Leaf and Chickasahay rivers.

The total amount expended on this improvement to June 30, 1897, was $199,640.77.

July 1, 1897, balance unexpended	$853.23
June 30, 1898, amount expended during fiscal year	812.74
July 1, 1898, balance unexpended	40.49
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	7,000.00

(See Appendix S 6.)

7. *Chickasahay River, Mississippi.*—The original condition of this river was such that only small rafts could be carried down during high water, and then it was troublesome and dangerous. The minimum width of the channel was 50 feet and the minimum depth 6 inches, and it was filled with logs and snags.

The original project for the improvement of this river—that of 1890—was to obtain a good high-water channel from the mouth up to the railroad bridge at Shubuta, Miss., by the removal of snags, logs, overhanging trees, etc., at an estimated cost of $30,000.

In the river and harbor act passed June 3, 1896, the original project was modified so as to carry the improvement only as far as the railroad bridge near Bucatunna, Miss., and the improvement has been limited to that section of the river.

The condition of the improvement on June 30, 1897, was such as to allow small steamboats to navigate to Bucatunna, Miss., on a 4-foot rise.

The total amount expended on this improvement to June 30, 1897, was $16,970.96.

July 1, 1897, balance unexpended	$29.04
July 1, 1898, balance unexpended	29.04
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	2,500.00

(See Appendix S 7.)

8. *Leaf River, Mississippi.*—The original condition of the channel of this river was such that navigation was impossible on account of snags, stumps, logs, and overhanging trees. The minimum width of the river channel was 100 feet and the minimum depth 2½ feet.

The project of 1890 was to obtain a high water channel from the mouth of Bowie Creek to the mouth of the river, an estimated distance of 75 miles, by the removal of snags, stumps, logs, and overhanging trees, at an estimated cost of $25,000.

The amount expended on the improvement of this river up to June 30, 1896, is $9,676.40, of which $3,084.28 was in preservation of the improvement.

The condition of the improvement on June 30, 1897, was such as to allow light-draft boats and large rafts of logs and timber to navigate the river for a distance of 60 miles from the mouth up.

The amount expended during the fiscal year ending June 30, 1897, resulted in giving a greater depth and width of channel from Bowie Creek down to Carters Bluff, 56 miles, making steamboat navigation and rafting more secure.

This virtually completed the project.

The total amount expended on this improvement to June 30, 1897, was $14,103.32.

July 1, 1897, balance unexpended	$896.68
June 30, 1898, amount expended during fiscal year	120.46
July 1, 1898, balance unexpended	776.22
July 1, 1898, outstanding liabilities	30.00
July 1, 1898, balance available	746.22
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	3,000.00

(See Appendix S 8.)

9. *Pearl River, below Jackson, Miss.*—The original condition of this river was such as to allow navigation only during high water, and then it was difficult and dangerous. The minimum width of the stream was 190 feet, and that of the channel was 100 feet except through Holmes Bayou, 7 miles, where it was 65 feet. The minimum depth of the channel was 1½ feet.

The project of 1880 was to obtain a 5-foot channel at low water, but this depth was found impracticable and the project was modified in 1885 so as to provide for a 2-foot channel at low water, at an estimated cost of $145,940.

By the river and harbor act of June 3, 1896, the original project for

improving Pearl River from Jackson to the mouth was modified so as to confine operations between the head of Homes Bayou and Monticello, Miss.

The condition of the improvement of this section of river on June 30, 1897, was such as to allow light-draft boats to navigate all the year from the mouth up to Monticello, 160¾ miles.

The total amount expended on this improvement to June 30, 1897, was $143,896.52.

July 1, 1897, balance unexpended	$14,228.48
June 30, 1898, amount expended during fiscal year	3,402.77
July 1, 1898, balance unexpended	10,825.71
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	7,000.00

(See Appendix S 9.)

10. Pearl River between Carthage and Jackson, Miss.—The original condition of this part of the river was such as to make navigation almost impossible, except at high water. The minimum width of the river was 100 feet and of the channel 40 feet. The minimum depth was about 1 foot. The project of 1879 was to afford a clear channel of navigable width and 5 feet depth at low water from Carthage to Jackson, 105 miles.

In 1888 the original project was modified to provide for a depth of 2 feet, at an estimated cost of $50,000.

This project is now completed.

The condition of this improvement on June 30, 1897, was such as to allow light-draft boats to navigate, on a 3-foot rise, from Carthage to Jackson, 105 miles, and the present condition is about the same.

The total amount expended on this section of the river to June 30, 1897, was $33,950.40.

Commercial statistics.

Articles.	1898.	1897.	1896.
	Tons.	*Tons.*	*Tons.*
Cotton	30	50	300
Staves	150	200	270
Total	180	250	570

July 1, 1897, balance unexpended	$2,099.60
June 30, 1898, amount expended during fiscal year	1,467.40
July 1, 1898, balance unexpended	632.20
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	2,500.00

(See Appendix S 10.)

11. Pearl River between Edinburg and Carthage, Miss.—The original condition of this portion of the river was such that navigation at low water was impossible and at high water was difficult and dangerous. The minimum width of the channel was 30 feet and the minimum depth at low water 3 inches.

The project for its improvement, adopted in 1884, was to afford a high-water channel from Edinburg to Carthage, a distance of 24¾ miles, for six or eight months of the year, at an estimated cost of $13,464.

The project has been entirely completed, and the condition of the river on June 30, 1897, was such as to allow navigation by light-draft boats on a 4-foot rise.

The total amount expended on this improvement to June 30, 1897, was $15,957.

No work was done on this section of the river during the past fiscal year, and there has been no commerce.

July 1, 1897, balance unexpended	$293.00
June 30, 1898, amount expended during fiscal year	1.12
July 1, 1898, balance unexpended	291.88
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	1,000.00

(See Appendix S 11.)

12. Bogue Chitto, Louisiana.—The original condition of this river was such as to make navigation, except during very high water, impossible, owing to shoals and sand bars at the mouth and obstructions in the river above. The minimum width of the channel was 80 feet and the minimum depth 3 feet.

The project of 1890 was to obtain a clear 3-foot channel during the greater part of the year by opening the mouth and the removal of logs, snags, trees, fish traps, etc., up to Alford's bridge, a distance of 190 miles, at an estimated cost of $55,000.

The work done during the year ending June 30, 1898, resulted in giving a 3-foot channel, but not of sufficient width. The sand bars at the mouth have been removed. The river for a distance of 1¼ miles from the mouth up has been widened from 20 to 50 feet and deepened to 5 feet.

The total amount expended on this improvement to June 30, 1897, was $16,223.42.

The present condition of the river admits of the passage of light-draft boats and large rafts of logs and timbers for 79¾ miles on a 3-foot rise.

Commercial statistics.

Articles.	1898.	1897.	1896.
	Tons.	*Tons.*	*Tons.*
Saw logs and timber (pine)	8,457	6,720	6,750
Saw logs (cypress)	4,475	60	.....
Total	12,932	6,780	6,750

July 1, 1897, balance unexpended	$3,776.58
June 30, 1898, amount expended during fiscal year	2,473.05
July 1, 1898, balance unexpended	1,303.53
July 1, 1898, outstanding liabilities	6.89
July 1, 1898, balance available	1,296.64
Amount that can be profitably expended in fiscal year ending June 30, 1900. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	7,000.00

(See Appendix S 12.)

13. Survey for canal between Warrior River and Five-mile Creek, Alabama.—This survey was provided for by the sundry civil act of June 4, 1897. The survey has been completed, and the maps and drawings are now being prepared. The report will be duly submitted when received from the local officer.

(See Appendix S 13.)

Major Rossell was also charged with the duty of making surveys of the following localities, reports of the results of which will be duly submitted when received:

1. Channel from Ship Island Harbor to Gulfport, Miss.; also *Ship Island Pass, Mississippi.*

2. Horn Island and Pass, Mississippi.

INSPECTION OF THE IMPROVEMENT OF THE SOUTH PASS OF THE MISSISSIPPI RIVER.

The act of Congress of March 3, 1875, amended by acts of June 19, 1878, and March 3, 1879, made provision for the construction, by James B. Eads or his representatives, of jetties and other works in South Pass of the Mississippi River, to secure and maintain a channel 26 feet in depth through the pass, and through the jetties at the mouth of the pass a channel "26 feet in depth, not less than 200 feet in width at the bottom, and having through it a central depth of 30 feet without regard to width." An annual payment of $100,000 was provided for the maintenance of such a channel for twenty years after first obtaining it by the works built. The required channels were secured in July, 1879.

The required channel was maintained during the year through the shoal at the head of South Pass and through the pass itself, except during sixty-three days, when the channel in Grand Bayou Reach, Goat Island Reach, and near the foot of Goat Island, did not contain the required depth.

The required channel "through the jetties," and beyond them to deeper water in the Gulf, was maintained during the year, except for four days.

During the year the dredge boat worked sixty days in South Pass, fifty days in the jetty channel, and five days in the channel beyond the ends of the jetties.

The object of the examination and surveys of South Pass is to determine if the channel is maintained as required by law, and to enable an engineer officer to issue the certificates for the quarterly payments, and "such other information as the Secretary of War may direct."

The expenses of this work are now provided for by a permanent-indefinite appropriation made by act of August 11, 1888, and up to June 30, 1896, the unexpended balance from year to year was available for the succeeding year; since that date the balance has reverted to the Treasury, and as the expenses are greater some years than others a deficit will result at times unless the unexpended balance be made available or an additional appropriation made. The correspondence on this subject was printed in House Doc. No. 296, Fifty-fourth Congress, second session; also in the Annual Report of the Chief of Engineers for 1897, page 1748.

The officer in charge of these surveys is Maj. James B. Quinn, Corps of Engineers, whose annual report is submitted as Appendix T.

IMPROVEMENT OF RIVERS AND HARBORS IN SOUTHERN LOUISIANA AND EASTERN TEXAS.

This district was in the charge of Maj. James B. Quinn, Corps of Engineers, having under his immediate orders Lieut. Frederick W.

Altstaetter, Corps of Engineers, since December 6, 1897, and Capt. Henry Jervey, Corps of Engineers, since April 15, 1898. Division Engineer, Col. Henry M. Robert, Corps of Engineers.

1. *Chefuncte (Tchefuncte) River and Bogue Falia, Louisiana.*—Previous to improvement these streams were obstructed by snags, logs, etc., and there was but a depth of 4½ feet of water over the bar at the mouth at the lowest stage.

The project for improvement, adopted in 1880 and modified in 1884, provided for the removal of obstructions in the channel, the building of a breakwater across the bar, and the dredging of the bar.

In 1881 and 1882 two appropriations were made, aggregating $3,000, with which 820 feet of breakwater was constructed and obstructions removed below Covington. As the bar would likely re-form, it was not dredged. The officer in charge in 1884 recommended that a breakwater extending 2,500 feet into the lake be constructed, and that the bar afterwards be dredged.

The improvement was originally estimated to cost $5,460, excluding the breakwater.

With the $2,500 appropriated in 1886, channels about 5 feet deep and 30 to 60 feet wide were cut through the bars in Bogue Falia, between Old Landing and Covington, improving navigation for schooners to the latter place.

Under the appropriation of $1,000 made in 1890, obstructions were removed from Madisonville to Old Landing, thence to Covington, on the Bogue Falia, with the Government snagging plant and hired labor.

The snagging plant was extensively repaired with the $1,000 appropriated in 1892.

In 1894, $1,000 was appropriated for maintenance. With this the bars in the river below Covington were dredged, creating channels 6 feet deep and 60 feet wide, through which steamers drawing 5 feet navigated from Covington to the mouth of the river, a distance of 14 miles.

By act of June 3, 1896, $1,000 was appropriated for maintenance, but on account of work required to be done at the mouth, and on the two bars near Covington, this amount was deemed insufficient and was not expended, but has been held for increase.

It is estimated that about $1,000 annually will be required to maintain this improvement.

The amount expended to June 30, 1897, was $8,349.29.

The amount of commerce involved is $723,833.

July 1, 1897, balance unexpended	$1,150.71
June 30, 1898, amount expended during fiscal year	44.50
July 1, 1898, balance unexpended	1,106.21
July 1, 1898, outstanding liabilities	10.00
July 1, 1898, balance available	1,096.21
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	1,000.00

(See Appendix U 1.)

2. *Tickfaw River and its tributaries, Louisiana.*—The original project for the improvement of the Tickfaw River and its tributaries (Natalbany, Blood, and Ponchatoula rivers) was adopted in 1881, and provided for the removal of obstructions from the streams at an estimated cost of $10,230.

With appropriations aggregating $10,000, about 30 miles of the Tick-

faw River and its branches was improved under this project, the work being carried on from 1881 to February, 1895. The work resulted in a material increase to the commerce of the river.

Under the appropriation of $1,000 made by act of June 3, 1896, a contract was entered into for hire of a boat for clearing the stream of water hyacinths, which impeded navigation. This work was carried on from February 26, 1897, to March 31, 1897, and about 2 miles of the stream was temporarily cleared near the mouth, but the plants soon choked the course again, impeding navigation.

It is estimated that $1,000 will be required annually for maintenance of the improvement, exclusive of removal of water hyacinths.

The amount expended on these improvements to June 30, 1897, was $10,853.06.

The amount of commerce involved in this improvement amounted to $436,388.

July 1, 1897, balance unexpended	$146.94
June 30, 1898, amount expended during fiscal year	4.45
July 1, 1898, balance unexpended	142.49
July 1, 1898, outstanding liabilities	10.00
July 1, 1898, balance available	132.49
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	1,000.00

(See Appendix U 2.)

3. *Amite River and Bayou Manchac, Louisiana.*—Prior to any improvement, Amite River and Bayou Manchac, its principal tributary, were navigable by small steamers for a short distance above and below their point of junction, but with danger from obstructions.

Under the project of 1880, the streams were cleared of obstructions in 1890 and 1891 from the mouth of the river to Bayou Manchac, thence up the bayou to Hope Villa, 13 miles of channel being improved.

In 1892 and 1894 appropriations aggregating $5,000 were made, with which the work of removing obstructions was continued. The turning basin at the mouth of Wards Creek, on Bayou Manchac, was completed in January, 1895.

An appropriation of $2,500 was made in June, 1896, for maintenance. The available funds will probably be expended in removal of obstructions which have formed since 1895.

No work was done on these streams during the past year.

At the mouth of Bayou Manchac, in the Amite River, snags and a sand bar, recently formed, are an impediment to navigation, and it is estimated that $2,500 will be required annually for maintenance.

The amount expended on this improvement to June 30, 1897, was $28,490.30.

The amount of commerce involved in this improvement is $516,477.

July 1, 1897, balance unexpended	$2,809.70
June 30, 1898, amount expended during fiscal year	93.66
July 1, 1898, balance unexpended	2,716.04
July 1, 1898, outstanding liabilities	10.00
July 1, 1898, balance available	2,706.04
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	2,500.00

(See Appendix U 3.)

4. Bayou Lafourche, Louisiana.—Before this stream was improved it was thickly obstructed by logs, snags, etc. The object of the first project for its improvement, adopted in 1879, was the removal of such obstructions. Various appropriations, aggregating $30,000, were made, and work under the project carried on until 1885.

A project was submitted on June 11, 1886, providing for the construction of a lock at the head of the bayou to connect it with the Mississippi River. It provided for subsequently dredging a channel 75 feet wide and 5 feet deep at mean low water of the Gulf. The estimated cost of these improvements was $450,000, with $8,000 annually for maintenance and operation.

Under this project, and to provide for immediate dredging to relieve low-water navigation, the sum of $50,000 was appropriated August 11, 1888. Dredging was commenced at the head of the bayou, and, with appropriations aggregating $165,000 since then, has been continued at intervals.

Operations under a contract for dredging were begun July 6, 1896, on the bar at the head of the bayou and carried downstream about 3 miles beyond Thibodaux. Obstructions were also removed. These operations improved about 38 miles of channel and were of great benefit to the commerce of the bayou, giving sufficient water for the navigation of the bayou during the low-water season.

A modification of the project of 1886 was approved on September 23, 1896. This project suspended the matter of the lock construction and confined operations to dredging to maintain low-water navigation, the estimated cost of which was $25,000 per annum.

Owing to an emergency, the Government dredge *Ram* was borrowed from Capt. G. McC. Derby to remove the bar at the mouth of the bayou, but after working about 15 days in August, 1897, it was withdrawn for work elsewhere.

Contract was entered into on December 8, 1897, for the hire of a dredge boat for the continuation of the improvement. Operations under this contract were carried on from September 13, 1897, to February 1, 1898, when high water in the bayou caused the suspension of operations. Contract was entered into June 29, 1898, for hire of dredge boat for continuation of improvement. The amount to be expended under this contract is about $12,000.

The amount expended on this improvement to June 30, 1897, was $184,987.90.

The value of the commerce involved is $7,367,783.

July 1, 1897, balance unexpended		$60,012.10
June 30, 1898, amount expended during fiscal year		17,232.40
July 1, 1898, balance unexpended		42,777.90
July 1, 1898, outstanding liabilities	$77.00	
July 1, 1898, amount covered by uncompleted contracts	12,000.00	
		12,077.00
July 1, 1898, balance available		30,702.70
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		10,000.00

(See Appendix U 4.)

5. Bayou Plaquemine, Grand River, and Pigeon bayous, Louisiana.—In 1867 or 1868, Bayou Plaquemine was closed by a dam built by order of the police jury of Iberville Parish, shutting out the waters of the Mississippi River. Prior to this time the largest steamboat could pass through it into Grand Lake and other connecting water routes.

The project of 1885 provided only for dredging and cleaning Bayou Plaquemine of obstructions and for building a lock at the head of the bayou.

The protection of the bank of the Mississippi River at Plaquemine Bend was added to the project for improvement in 1888. The improvement of Grand River and Pigeon bayous was incorporated in the plan of improvement by act of July 13, 1893.

Bank protection was carried on under the appropriations of 1888 and those of later years. A channel 60 feet wide and 6 feet deep was also dredged. In 1893, 1894, and 1895 work was carried on in the Grand River and Pigeon Bayou routes, and the improvement extended for a distance of 25 miles, down to Grand Lake.

Under the appropriation of June 3, 1896, contract was entered into for dredging in Grand River and Pigeon Bayou. Operations under this contract were commenced March 26, 1897, and finished August 20, 1897. A large quantity of material and numerous obstructions were removed, greatly improving the channels.

A project for the construction of a lock was submitted in 1891, but actual construction was delayed for want of funds. On June 24, 1895, a contract was entered into for construction of cofferdam, excavating, and driving a pile foundation for lock. Operations under this contract were commenced on September 1, 1895. Work progressed more slowly than expected on account of unforeseen difficulties the contractor had to deal with. A large portion of the excavated material was washed back into the pit by a severe storm in June, 1896, and two months later a dangerous movement of the slopes on the end of the pit near the river required that a large quantity of material not originally contemplated be removed. A supplemental contract for the removal of 60,000 cubic yards of this material was approved February 27, 1897.

Another supplemental contract was approved June 19, 1897, for driving 800 piles of 60-foot lengths, instead of 800 piles of 50-foot lengths.

The contractor completed all the work contemplated in the original and supplemental contracts on December 31, 1897. Under contract with Mr. F. C. Leroy the pit of the lock has been constantly drained since the completion of the work, in order that same might be turned over in good condition when other operations were commenced.

Under the provisions of act of June 3, 1896, authorizing continuing contract, plans and specifications for the construction of lock and approaches were submitted and approved during the past year, and contract was entered into May 28, 1898.

The total amount expended on this improvement to June 30, 1897, was $396,025.40.

The value of the commerce involved is $138,708.

July 1, 1897, balance unexpended		$433,974.60
June 30, 1898, amount expended during fiscal year		56,229.72
July 1, 1898, balance unexpended		377,744.88
July 1, 1898, outstanding liabilities	$409.00	
July 1, 1898, amount covered by uncompleted contracts for fiscal year 1899	*350,000.00	
		350,409.00
July 1, 1898, balance available		27,335.88
Amount (estimated) required for completion of existing project		878,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1900		400,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix U 5.)

* The approved continuous contract calls for the expenditure of $501,757.60.

6. Bayou Courtableau, Louisiana.—When the present project was adopted a large deposit of sand, known as Little Devil Bar, had formed at the mouth of the bayou by the backwater from the Atchafalaya River.

The project of 1880 provided for closing some run-out bayous, throwing all the water into the channel of the Courtableau, and causing its current to wash out the bar at its mouth.

The project was completed November 9, 1895, under appropriations made from time to time, aggregating $36,200.

During low water in 1891 the dams were placed in thorough repair.

In 1894 an appropriation of $5,000 was made for continuing the improvement. The approved project provided for the closure of Bayous Fordoche, Mamzelle, Big and Little Cane, and, if funds would permit, to close the small bayous between Mamzelle and Big Cane. This work was finished on November 9, 1895, being done by contract.

A large raft of logs, completely obstructing navigation, formed near the mouth of the bayou during the high water of 1896. The raft formed where the current of the bayou and the backwater of the Atchafalaya neutralized each other, and is now about 3 miles long. An appropriation of $2,500 for the removal of this raft was made June 3, 1896. Proposals were invited for the removal of the raft, but no satisfactory bids were received, owing to the insufficiency of the amount on hand out of which to pay for the work. An agreement was made with Mr. Ed. C. Pearson, of New Orleans, La., to clear the channel, the agreement to remain in force until February 28, 1898, but Mr. Pearson never took any measures to carry out its provisions.

On account of the formation of the raft in the mouth of the bayou no vessel of any kind can pass in or out. This embargo upon navigation has lasted since April 11, 1896, the commerce by water having, in consequence, dwindled from a value of $3,917,344 in 1891 to nothing in 1896–97 and in 1897–98.

The steamboatmen, merchants, and farmers represent their losses as serious; the former because of the nonemployment of their boats, the latter through additional trouble and expense in hauling products and supplies.

The amount available for the removal of the raft is inadequate, and must be increased by at least $20,000 to secure the restoration of commerce. As the drift is constantly accumulating, the early removal is important from an economical point of view.

The sum of $35,454.46 was expended in improving this stream up to June 30, 1897.

The value of the commerce involved in this improvement, as shown by commercial statistics accompanying Annual Report of 1896, is $103,944.

July 1, 1897, balance unexpended	$3,245.54
June 30, 1898, amount expended during fiscal year	22.25
July 1, 1898, balance unexpended	3,223.29
Amount that can be profitably expended in fiscal year ending June 30, 1900 submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	20,000.00

(See Appendix U 6.)

7. Bayou Teche, Louisiana.—Previous to improvement the channel had a depth of 8 feet, but navigation was impeded and rendered unsafe by obstructions. The removal of these obstructions was contemplated by the initial project, and from 1870 to 1894, six appropriations having

been made, 70 miles of the channel was improved. The benefits were but temporary, the obstructions again forming.

Detailed history, progress of the work, and results of the improvement are given in Appendix R, pages 1503–1504, Annual Report of the Chief of Engineers for 1896.

Act of June 3, 1896, appropriated $10,000 for dredging and removing obstructions from the bayou. Operations were carried on, under contract, from November 16, 1896, to March 22, 1897, giving a clear channel 60 feet wide and averaging 5 feet in depth, between St. Martinville and Charenton, a distance of 44½ miles.

No work has been done on this stream during the year just ended.

Several obstructions have formed in the bayou below St. Martinville which require attention. It is believed that to remove these obstructions will cost $10,000, and that an annual appropriation of $2,000 will be essential to preserve uninterrupted navigation.

The amount expended on this improvement to June 30, 1897, was $70,579.67.

The amount of commerce involved in this improvement is $5,253,067.

July 1, 1897, balance unexpended	$420.33
June 30, 1898, amount expended during fiscal year	59.80
July 1, 1898, balance unexpended	360.53
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	10,000.00

(See Appendix U 7.)

8. *Channel, bay, and passes of Bayou Vermilion, Louisiana.*—The primary project, approved in 1892, provided for the removal of obstructions from the bayou and marking the channel in the bay with guide piles. The cost was estimated at $25,000.

With appropriations amounting to $12,500, work under this project was carried on from December 1, 1892, to August 27, 1895. The channel in the bay was marked with guide piles and obstructions were removed from a point 18 miles above the mouth of the bayou to 26 miles above Abbeville, La.

In Appendix R, pages 1505–1506, Annual Report of Chief of Engineers for 1896, will be found details of history, progress of the work, and results obtained by the improvement.

There was appropriated by act of June 3, 1896, $1,000 for continuing the improvement. Nothing has been done with this amount, it having been held for an additional appropriation to cover the work required to be done at several different places.

There was expended on this improvement to June 30, 1897, the sum of $12,387.58.

The amount of commerce involved in this improvement is $333,375.

July 1, 1897, balance unexpended	$1,112.42
June 30, 1898, amount expended during fiscal year	54.87
July 1, 1898, balance unexpended	1,057.55
Amount (estimated) required for completion of existing project	11,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	5,000.00

(See Appendix U 8.)

9. *Mermentau River and tributaries, Louisiana.*—Prior to improvement, Mermentau River and its tributaries were obstructed by snags, logs,

etc. A survey of these streams was made in 1891, and in 1892 the first project for improvement was adopted. This project provided for the removal of snags and logs in the upper river and a mud flat in the lower, at an estimated cost of $23,615.25.

Under act of July 13, 1892, the sum of $7,500 was appropriated for this work and obstructions were removed from the lower end of Lake Arthur to a point about 38 miles up Mermentau River, rendering navigation safer.

Under the appropriation of $5,000 made in 1894 for continuing the improvement, a project was submitted, but as the funds available were small it was not deemed advisable to undertake the work until further appropriations had been made.

Congress appropriated $5,000 on June 3, 1896, and on June 15, 1897, a project was approved under which dredging was to be done and brush dams constructed to secure a channel through Mud Lake.

On November 1, 1897, contract was entered into for dredging and constructing brush dam in Mud Lake.

Dredging operations were commenced December 24, 1897, and completed March 4, 1898, a distance of 4,417 feet being dredged, embracing the cutting through of two bars. Work on the upper and lower dams was finished on April 14, 1898. The upper dam is now 2,500 feet long and 5 feet wide, and the lower dam is 3,000 feet long. The average depth of both bars is 8 feet, and width 50 feet.

There had been expended on this improvement to June 30, 1897, the sum of $7,312.07.

In the lower end of Grand Lake the water shoals to 2½ feet. The Nepuque and Quetortie, two tributary streams of growing importance, are obstructed with snags and overhanging trees, the removal of which will be of great assistance to commerce.

The amount of commerce involved in this improvement is $350,870.

July 1, 1897, balance unexpended	$10,187.93
June 30, 1898, amount expended during fiscal year	9,268.69
July 1, 1898, balance unexpended	919.24
Amount (estimated) required for completion of existing project	6,115.25
Amount that can be profitably expended in fiscal year ending June 30, 1900	6,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix U 9.)

10. Mouth and passes of Calcasieu River, Louisiana.—Prior to improvement there was a depth of only 3 feet over the bars in Calcasieu Lake. In 1874, 1882, and 1883 a channel 8 feet deep and 70 feet wide for a distance of 7,500 feet was dredged through the bars in the lake above Calcasien Pass. This channel shoaled and in 1885 possessed a depth of only 3½ feet.

In 1886 contract was entered into to build two revetment walls and dredge between them, also to dredge a channel through the bar at the mouth of Calcasieu River 6 feet deep and 100 feet wide. The contract was annulled in January, 1888, and the project modified so as to omit the revetment.

From March 19, 1888, to August 31, 1888, 77,159 cubic yards of material was taken out with the Government dredge.

An appropriation of $10,000 was made in 1888 for continuing the improvement. The sum of $75,000 was appropriated in 1890 for "improving the mouth and passes of Calcasieu River." The amounts available were held for further increase, they being considered too small to conduct operations economically.

In 1892, $100,000 additional was appropriated, following which a contract was entered into for constructing a jetty on the east side of the channel, across the bar at the mouth of the pass, and for 10,000 linear feet of revetment on the northern side of the channel, and for dredging through the bar. On August 6, 1893, the revetment was completed, and the dredging was done with the Government dredge in November, 1894, which work finished the channel at the foot of Calcasieu Lake. The dredging gave considerable relief, and vessels drawing 6½ feet pass through with safety. Work on the east jetty was finished on August 11, 1894, leaving it 7,347 feet long.

The project approved August 17, 1894, provides for dredging channels through the bar at the head of Calcasieu Lake, capping 7,000 feet of the east jetty with stone, and with the balance unexpended to dredge a channel 12 feet deep from the 12-foot contour inside to the 12-foot contour outside, and as wide as funds would permit.

From November 5, 1894, to June 30, 1895, dredging was carried on at the head of the lake, giving a channel 50 feet wide and 8 feet deep.

Under the appropriation of $90,000 made in 1894 a contract was made for capping the east jetty with stone. Work was carried on from January 28, 1895, to August 8, 1895, capping 6,552 linear feet of jetty.

Contract for extending east jetty was approved March 2, 1896, and work was carried on from May, 1896, to August 4, 1896, giving the jetty a total length of 7,847 feet.

A contract for building the west jetty was entered into under the appropriation of $80,000, June 3, 1896, and work was carried on from January 1, 1897, to June 15, 1897, giving a length of 2,200 feet to this jetty. Of this, 1,275 feet was capped and completed, and 875 feet brought up to mean high water, ready for capping. The 100 feet remaining is foundation work only.

On April 6, 1898, contract was entered into with Charles Clarke & Co., Galveston, Tex., for operating the Government dredge in Calcasieu Lake, Louisiana. It is contemplated by this work to restore the dredged channel, 50 feet wide and 8 feet deep, from deep water in Calcasieu Pass to deep water in Calcasieu Lake, a distance of about 2 miles. The amount available for this improvement is about $9,000. Operations were commenced on May 26, 1898, and up to June 30, 1898, 16,118 cubic feet of material was dredged and a number of piles removed that had been washed in from the revetment.

The damages to the east jetty will require attention soon, as sand drifts through the breach in the jetty and shoals the channel.

The amount expended on this improvement to June 30, 1897, was $386,612.77.

The amount of the commerce involved is $745,071.

July 1, 1897, balance unexpended		$14,887.23
June 30, 1898, amount expended during fiscal year		1,863.80
July 1, 1898, balance unexpended		13,023.43
July 1, 1898, outstanding liabilities	$126.26	
July 1, 1898, amount covered by uncompleted contracts	9,000.00	
		9,126.26
July 1, 1898, balance available		3,897.17

Amount (estimated) required for completion of existing project	255,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix U 10.)

11. Harbor at Sabine Pass, Tex.—Before any improvement was made the bar obstructing the entrance to the harbor at Sabine Pass, Tex., had not more than 5 feet of water upon it. In 1878 and 1880 channels from 12 to 15 feet deep were dredged through it, but soon filled up. The project of 1882 provided for constructing jetties on either side of the channel connecting the deep water of the pass with that of the Gulf, at an estimated cost of $3,177,606.50.

Since 1883 work on the jetties was carried on as fast as appropriations would permit.

On June 30, 1896, the west jetty was 14,875 feet long, 6,609 feet of which being raised 2 feet above mean high water, 7,966 feet to mean low water, the remaining 300 feet being foundation work. The dredged channel had an average width of 100 feet and a depth of 24 feet. No work was done during the fiscal year ending June 30, 1897, on the west jetty or on the channel.

On June 30, 1897, the east jetty had a total length of 19,500 feet, 18,600 feet of which had been completed, 600 feet brought up to mean low water, the remaining 300 feet being foundation work. The dredged channel had an approximate width of 100 feet and a depth of from 20 to 27 feet. As the bottom is of soft material, vessels drawing 22 feet experienced no difficulty in passing over the 20-foot channel.

The river and harbor act of June 3, 1896, authorized contracts to be entered into for completing the present project of improvement, to be paid for as appropriations may be made by law. The sundry civil act approved June 4, 1897, appropriated $350,000 for improvement under the continuous-contract system, $100,000 for the purchase of a dredge boat, and $30,000 for operating same during the fiscal year ending June 30, 1898.

As authorized by the act of June 3, 1896, a continuing contract was approved June 22, 1897, for jetty construction. It was proposed to expend $65,000 of the appropriations either in the addition of necessary rock to the jetties or in dredging between the jetties to improve the channel.

Work was commenced by the contractors on August 10, 1897, and up to June 30, 1898, the east jetty had been extended 4,100 feet, of which about 2,000 feet had been brought up to low-water level. The west jetty was capped with 9,647 tons of granite blocks, completing same for a distance of about 3,000 feet. Dredging in channel was carried on until October, resulting in removing 299,799 cubic yards of material.

On October 18, 1897, proposals were opened for building the dredge boat authorized under project approved June 29, 1897, for improving the channel. All bids, however, were rejected as not conforming to specifications. It is expected that new proposals will be invited in the near future.

Act of Congress approved March 17, 1898, makes available for immediate use $15,000 of the $30,000 appropriated by sundry civil act approved June 4, 1897. The project for the expenditure of this amount, approved March 28, 1898, provides for clearing and widening the channels at Sabine Pass by dredging, etc.

Under this project contract was entered into June 15, 1898, for dredging between the jetties in the channel.

Soundings were made in the channel on June 14–17, 1898, and the depth of water over the shoalest locality was found to be 22.4 feet at mean low water of the Gulf and 23.9 feet at mean high water. Outside of the dredged channel the depth shows a considerable improvement, under the action of natural scour.

Since the commencement of work there has been expended on this improvement to June 30, 1897, the sum of $2,042,243.51.

The amount of commerce involved in this improvement is $2,363,542.

July 1, 1897, balance unexpended		$552,506.49
Amount appropriated by sundry civil act approved July 1, 1898		400,000.00
		952,506.49
June 30, 1898, amount expended during fiscal year		191,106.56
July 1, 1898, balance unexpended		761,399.93
July 1, 1898, outstanding liabilities	$45,495.97	
July 1, 1898, amount covered by uncompleted contracts	1,050,000.00	
		1,095,495.97
Amount (estimated) required for completion of existing project		628,856.50
Amount that can be profitably expended in fiscal year ending June 30, 1900		300,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix U 11.)

12. Sabine River, Texas.—At the mouth of the river and above the town of Orange there was 3½ feet of water over the bar prior to improvement.

The cost of improvement was originally estimated at $18,000, and provided for removal of logs, snags, etc.

A channel 6 feet deep and 70 to 100 feet wide was dredged through the bar at the mouth in 1878.

A resurvey of the river was made in 1879, and cuts dredged from the main river into the Narrows and at Dead Bend, and obstructions removed, enabling vessels of 5-foot draft to go 30 miles above Orange.

In 1880 and 1881 the bar at the mouth, for about 1 mile, was redredged 6 feet deep and 100 feet wide.

In 1889 obstructions were removed and the two branches of Old River closed, throwing the water into the Narrows.

In 1892 about 17½ miles of channel was cleared of obstructions.

With $5,000, appropriated by act of 1894, the project of 1892 was completed, resulting in the improvement of the river from Morgans Bluff to Cypress Bayou—a distance of 20 miles—which left the river in fair condition to Sudduths Bluff.

Under an allotment made by act of March 2, 1895, from the appropriation of August 18, 1894, for improving Sabine Pass, for dredging through the bar at the mouth of the river, a channel 50 feet wide and 8 feet deep from deep water in the river to deep water in the lake was dredged.

The dams built in 1890 and that part of the stream cleared in 1895 were found to be in good condition in May, 1897.

The project approved June 9, 1897, proposed to remove obstructions from Morgans Bluff to the head of the Narrows with the appropriation of $2,000 made by act of June 3, 1896. Bids for doing this work were asked in August, 1897, but none were received, and the amount available, being too small to accomplish the object sought, is held for increase.

During high-water season vessels navigate the river for a distance of 652 miles above the mouth, but this condition prevails only about three months each year. At several places sunken logs form obstructions to navigation. Some of these obstructions are only 2 feet under water.

The amount expended on this improvement to June 30, 1897, was $48,573.77.

The amount of commerce involved in this improvement is $1,394,557.

It is estimated that $2,000 will be required annually for maintenance of the improvement.

July 1, 1897, balance unexpended	$2,126.23
June 30, 1898, amount expended during fiscal year	118.66
July 1, 1898, balance unexpended	2,007.57
July 1, 1898, outstanding liabilities	16.67
July 1, 1898, balance available	1,990.90
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	2,000.00

(See Appendix U 12.)

13. Closing crevasse in Pass a Loutre, Mississippi River.—This crevasse forms an outlet from Pass a Loutre into an arm of the Gulf known as Garden Island Bay, and was caused by the wearing away of the south bank of that pass at a locality 1¾ miles below the Head of Passes, at which point the water of the Mississippi River divides and flows to the Gulf through three passes.

In 1872 there was a ditch about 3 feet wide from the river into the bay at the locality where the crevasse first broke. This increased slightly from year to year, and the narrow strip of land dividing the river from the Gulf gradually became narrower.

During the month of January, 1891, the width of the crevasse began to increase rapidly, but, with the river rising, nothing could be done to stay its progress. In July, 1891, it was 860 feet wide and 25 feet deep.

On October 3, 1891, the estate of James B. Eads undertook to close the crevasse by building a dam across the mouth of it, but the work was abandoned on January 14, 1892.

On August 3, 1892, the crevasse was 1,660 feet wide.

On July 29, 1893, work was again commenced by the Eads estate in another attempt to close the crevasse. By this time the deep water produced by the crevasse extended into the bay for five-eighths of a mile. The work of building a dam to encompass this deep water progressed favorably until October 1, 1893, when it was interrupted and damaged by a severe storm. Work was continued until April 14, 1894, when it was temporarily discontinued on account of high river. It was resumed on September 1, 1894, and on October 7 and 8, 1894, another violent storm damaged the work so badly that the closure of the crevasse seemed a hopeless task and was permanently abandoned. On November 18, 1896, the crevasse was 2,230 feet wide and has not materially increased since.

The act of Congress approved February 26, 1897, appropriated $250,000 for the closure of this crevasse.

The approved project, under this appropriation, calls for a dam 6,650 feet long, in two sections, 1,900 and 4,750 feet in length, respectively, which form an angle of 112° at a distance of 3,000 feet below the mouth of the crevasse.

A contract for the work was approved December 10, 1897.

The contractors were much delayed in commencing the work on account of quarantine restrictions. The work of driving piles began December 14, 1897, and on January 27, 1898, there was 2,400 feet of the dam completed. By this time the river had reached a stage of 9.5 feet on Carrollton gauge, and the current became so strong as to render fur-

ther prosecution of the work difficult, and it was discontinued until the river should again be at a low stage.

On the morning of January 27, 1898, the dam gave away at one locality and 75 feet of it was quickly washed out. On January 31, 1898, the break was 123 feet wide; on February 7, 372 feet; on February 14, 432 feet; on February 26, 438 feet, from which time to April 2 it remained unchanged, when it became 462 feet wide. The width of the break on June 23, 1898, was 492½ feet.

On May 1 the extreme east end of the work began to undermine, and 29½ feet has been lost from that end.

This makes a total of 522 feet of complete work which has been lost, leaving 1,878 feet now in place.

As the river is now falling, the contractors will probably resume work in a short time.

Survey of Southwest Pass, Mississippi River.—Act approved February 17, 1898, provides for a survey and report, by a Board of Engineer Officers, upon the practicability of securing a channel of adequate width and of 35 feet depth at mean low water of the Gulf of Mexico, throughout Southwest Pass of the Mississippi River.

For the purpose of making this survey the sum of $10,000 was allotted from the appropriation for closing crevasse in Pass a Loutre, Mississippi River.

The survey was begun on March 24, 1898, and practically completed on April 15, 1898. A small party was then organized to obtain daily discharge measurements of Southwest Pass, accompanied by measurements of the other two passes as frequently as possible. The field work of the survey is now being platted and reduced in office and the report of results will be duly submitted when received.

July 1, 1897, balance unexpended		$250,000.00
June 30, 1898, amount expended during fiscal year		70,672.82
July 1, 1898, balance unexpended		179,327.18
July 1, 1898, outstanding liabilities	$8,711.80	
July 1, 1898, amount covered by uncompleted contracts	121,496.04	
		130,207.84
July 1, 1898, balance available		49,119.34

(See Appendix U 13.)

14. Removing sunken vessels or craft obstructing or endangering navigation.—An allotment of $1,500 was made for removing a sunken barge in Lake Pontchartrain, and contract for its removal was approved May 1, 1897. Operations were commenced May 5, 1897, and completed July 28, 1897.

The amount expended during the fiscal year ending June 30, 1898, was $441.83.

(See Appendix U 14.)

PLAN AND ESTIMATE OF COST OF IMPROVEMENT OF HOMOCHITTO RIVER, MISSISSIPPI.

The plan and estimate of cost of improvement of Homochitto River, Mississippi, from and including its mouth to the Yazoo and Mississippi Valley Railroad, required by concurrent resolution passed the House of Representatives March 17, 1898, and agreed to by the Senate March 21, 1898, was submitted April 1, 1898.

Maj. James B. Quinn, Corps of Engineers, estimated that the obstructing snags and impending trees can be cleared out so as to give naviga-

tion on this river between its mouth and the Yazoo and Mississippi Valley Railroad for boats drawing not more than 6 feet of water for the sum of $16,000.

The report was transmitted to Congress and printed in House Doc. No. 404, Fifty-fifth Congress, second session. (See also Appendix U 15.)

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN TEXAS.

This district was in the charge of Lieut. Col. A. M. Miller, Corps of Engineers, to September 10, 1897, with Capt. Charles S. Riché, Corps of Engineers, under his immediate orders; in the charge of Captain Riché from September 10, 1897, to June 16, 1898, and of Maj. James B. Quinn, Corps of Engineers, since that date, the officers in charge having under their immediate orders Lieut. Harry Burgess, Corps of Engineers, since April 11, 1898.

1. Galveston Harbor, Texas.—Galveston harbor embraces an anchorage area of over 1,960 acres, of which 1,500 acres has a depth of more than 20 feet, and 460 acres has a depth of more than 30 feet. It affords vessels excellent shelter from storms. Waterways connect it with Houston and with Brazos River.

The entrance to this harbor was originally obstructed by two bars, known as the inner and outer. The natural depth on the inner bar was about 9½ feet, and on the outer bar about 12 feet. These shallow depths prevented all but the lightest draft vessels from using the harbor, and necessitated the lighterage of cargoes to the larger vessels anchored in the deep water beyond the outer bar.

Prior to 1874 the projects for improving this harbor related to dredging operations on a small scale, and were only expected to afford temporary relief to navigation.

The original project for the permanent improvement of this harbor was adopted June 23, 1874, and contemplated the construction of jetties, which were expected to deepen the channel on the bar to 18 feet, the cost being estimated at $1,759,400. (Annual Report of the Chief of Engineers for 1874, p. 722 et seq.) The method used in jetty construction having proved unsatisfactory, the subject of the improvement was referred to a Board of Engineers, which, on June 7, 1880, formulated a modified project which also contemplated the building of jetties at a cost of $1,825,813. It was expected that, upon their completion, a least depth of 25 feet would be obtained on the outer bar. (Annual Report of the Chief of Engineers for 1880, p. 1221 et seq.) On February 20, 1886, a Board of Engineers again considered the subject of this improvement and adopted a modified project which had in view a possible depth of 30 feet, by constructing the jetties to a height of 5 feet above mean low tide and extending them to the 30-foot contour in the Gulf, and to supplement the action of the tidal scour by dredging. The estimated cost of this revised project was $7,000,000, in addition to sums previously spent, which amounted to $1,478,000, making the aggregate cost of this improvement $8,478,000. (Annual Report of the Chief of Engineers for 1886, p. 1294 et seq.)

The total amount expended under the foregoing plans to June 30, 1897, was $7,901,364.89, with an additional sum of $100,000, subscribed by the city of Galveston in 1883.

This expenditure resulted in a depth of 24¾ feet at mean low tide on the outer bar, an increase of 12¾ feet since work began, and a depth of 25¼ feet at mean low tide on the inner bar, an increase of 15¼ feet

during the same period. This increased depth of water enables vessels to load to their full capacity at the Galveston wharves, thereby making the lighterage of cargoes no longer necessary.

The expenditure during the fiscal year ending June 30, 1898, was $349,801.58, and resulted in a further deepening of the water on the outer bar to 25½ feet and on the inner bar to 26 feet, also in a widening and straightening of the channel between the jetties.

At the end of the fiscal year the completed south jetty extended 35,603 feet. On the same date the completed north jetty extended a distance of 25,907 feet.

Commerce has been greatly benefited by the improvement of this harbor, as shown by the increased size and tonnage of the vessels using the port and in the large increase (1,720,242 tons) in the amount of freight handled.

The total amount of ocean commerce transported to and from Galveston during the fiscal year was: Cotton and cotton products, 630,590 tons; grain, 359,097 tons; coal, 169,002 tons; wool, 6,406 tons; ore, 3,370 tons; sugar, 7 tons; and general merchandise, 1,761,592 tons.

It will be necessary, for a time at least, to maintain a dredge at Galveston to remove any shoaling that may take place in the improved channel, and it is estimated that $50,000 will be required during the next fiscal year for the maintenance and operation of the dredge belonging to this improvement.

July 1, 1897, balance unexpended	$576,935.11
June 30, 1898, amount expended during fiscal year	349,801.58
July 1, 1898, balance unexpended	227,133.53
July 1, 1898, outstanding liabilities	14,840.95
July 1, 1898, balance available	212,292.58
Amount that can be profitably expended in fiscal year ending June 30, 1900, for operating dredge in maintaining channel between the jetties. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	50,000.00

(See Appendix V 1.)

2. *Ship channel in Galveston Bay, Texas.*—Galveston Bay is a large body of water, covering an area of about 455 square miles, and is situated north of the eastern end of Galveston Island and of Bolivar Peninsula. It is connected with the Gulf of Mexico by Bolivar Channel, and merges into West Galveston Bay at its southwestern extremity. Several rivers and bayous empty into the northern portion, and it was for the purpose of giving the commerce of those streams an outlet to the Gulf of Mexico that the dredging of a channel through the bay was undertaken. The natural depth along the line of the proposed channel varied from 4 to 8½ feet.

The project, adopted June 10, 1872, proposed dredging a channel 100 feet wide and 6 feet deep across Red Fish and Cloppers bars, at a cost of $62,805. (Annual Report of the Chief of Engineers for 1871, p. 533 et seq.) The river and harbor act of August 14, 1876, provided for a survey for a ship channel through Galveston Bay from 12 feet of water in the mouth of San Jacinto River to 12 feet of water in Galveston Channel. This survey resulted in a modified project being adopted on May 21, 1877, which had in view the dredging of a channel 100 feet wide at bottom and 12 feet deep through Galveston Bay from the lower end of Morgan Cut to Bolivar Channel, the cost being estimated at $446,326.42. (Annual Report of the Chief of Engineers for 1877,

p. 456 et seq.) In 1888 this amount was increased to $740,108.22, the former estimate having been found to be inadequate. (Annual Report of the Chief of Engineers for 1888, p. 1280 et seq.) On May 4, 1892, the United States purchased the "Morgan Cut and Canal," 5.43 miles long, from the Buffalo Bayou Ship Channel Company, for the sum of $92,316.85. This addition of 5.43 miles to the length of the ship channel made necessary a further revision in the estimated cost of the improvement. The amount was increased to $896,175.44, which, added to the amount paid for the Morgan Cut and Canal, made the total cost $988,492.29. In addition, it was estimated that an annual sum of $100,000 would probably be required for maintenance after completion of the channel. (Annual Report of the Chief of Engineers for 1892, p. 1536 et seq.)

The amount expended up to the close of the fiscal year ending June 30, 1897, was $800,328.16.

At that time a channel having a least depth of 8½ feet and width of 100 feet was available from Bolivar Channel to the Morgan Canal.

No work was done during the fiscal year, owing to the fact that the depth of water in the ship channel was greater than that found in Buffalo Bayou immediately at and below Houston, and was all that was demanded by the draft of vessels navigating this channel, Congress having also indicated, in an act approved February 1, 1897, a possible intention of again amending the project so as to obtain a least depth of 25 feet in the ship channel.

A gradual shoaling takes place along this channel when work is suspended. A survey made in March, 1897, gave a least depth of 8 feet along the channel line.

On the 26th of July, 1897, a Board met in Houston for the "examination and survey for a water route from the mouth of the jetties at the city of Galveston, Tex., through the ship channel and up Buffalo Bayou to Houston, Tex." The report of this Board is printed in House Doc. No. 99, Fifty-fifth Congress, second session; it is also submitted herewith as Appendix V 9.

It was the opinion of this Board that the interests involved justify the improvement proposed, at a cost of $4,000,000, with cost for maintenance of $100,000 annually.

The largest part of the commerce of Buffalo Bayou and Trinity River is carried through the ship channel to the deep water at Galveston. Detailed statements giving character and amounts will be found in the respective reports on those streams.

July 1, 1897, balance unexpended	$48,688.69
July 1, 1898, balance unexpended	48,688.69

(See Appendix V 2.)

3. Operating and care of Morgan Canal, Texas.—The expenses of caring for this canal during the fiscal year ending June 30, 1897, amounted to $360, which was paid from the permanent-indefinite appropriation provided by section 4, act of July 5, 1884. A statement contained in the report of the local engineer officer shows the items of expenditure.

(See Appendix V 3.)

4. Channel in West Galveston Bay, Texas.—West Galveston Bay is a body of water covering about 39 square miles, and lies between Galveston Island and the mainland. It extends from Galveston Bay to the west end of Oyster Bay, and is connected with the Gulf of Mexico by San Luis Pass, at the western extremity of Galveston Island, and

with the Brazos River by the Galveston and Brazos Canal. The natural depth of the bay was from 2½ to 3 feet.

The project for improving the bay was adopted on June 13, 1892, and consisted in widening, deepening, and straightening the channel so as to give a width of 200 feet and a least depth of 3½ feet from Galveston Bay to San Luis Pass and a channel 100 feet wide and 3 feet deep along Christmas Point in Oyster Bay, both channels to be properly defined by beacons. The estimated cost of the improvement was $28,998.80. (Annual Report of the Chief of Engineers for 1892, p. 1556 et seq.) On July 8, 1896, authority was given to modify the project so as to afford a depth of 5 feet, provided the cost of the work was not increased.

The amount expended to June 30, 1897, was $19,750.97.

This expenditure resulted in an unobstructed channel 100 feet wide and from 3 to 3½ feet deep from Galveston Bay to the Galveston and Brazos Canal. Beacons were also erected to define the channel.

No work was done during the fiscal year, for the reason that a greater depth of water existed in the bay than was found in the Galveston and Brazos Canal, which is owned by a private corporation having the right to charge tolls, and through which all vessels plying between Galveston and the Brazos River usually pass.

The amount ($25) expended during the fiscal year was applied to payment of account for collecting commercial statistics for fiscal year ending June 30, 1897.

The amount of freight carried through the bay during the year was 11,285 tons, of which 3,085 tons was cotton and 8,200 tons was general merchandise.

July 1, 1897, balance unexpended	$5,249.03
June 30, 1898, amount expended during fiscal year	25.00
July 1, 1898, balance unexpended	5,224.03

Amount (estimated) required for completion of existing project	4,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	4,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix V 4.)

5. *Trinity River, Texas.*—The improvement of this stream has been limited to that portion lying between the mouth and Liberty at the head of tide water, a distance of 39 miles. The river empties into Galveston Bay through several mouths or passes, opposite each of which a bar existed on which the depth of water did not exceed 3¼ feet at mean low tide.

The project adopted for this improvement on June 18, 1878, consisted in the removal of snags from the river below Liberty and in dredging a channel 80 feet wide by 6 feet deep across the bar at the mouth of the pass then in use by vessels. The estimated cost of the work was $22,581.40. (Annual Report of the Chief of Engineers for 1873, p. 685 et seq.) On May 4, 1889, an amended project was adopted. It contemplated the erection of two parallel jetties at the mouth known as the Middle Pass, placed about 275 feet apart, and extending about 7,750 feet into Galveston Bay; also in closing the other two principal passes by submerged dams, the object being to create and maintain a channel 6 feet deep at mean low tide at the mouth of the river. The revised cost of the improvement was placed at $89,500. (Annual Report of the Chief of Engineers for 1889, p. 1557 et seq.)

The amount expended on this improvement to the close of the fiscal year ending June 30, 1897, was $69,329.76.

At that date the west jetty had been completed, its length being 7,359 feet, and a channel 100 feet wide by 5 feet deep had been secured at the mouth of the river.

No work was done during the fiscal year, for the reason that there was sufficient depth of water on the bar at the mouth to accommodate all vessels navigating the river, and because by a retention of the available funds until a sufficient amount had accumulated to complete the work the east jetty could be more economically constructed.

The amount ($115) expended during the year was applied to removing a log jam at the mouth of the river and payment of account for collecting commercial statistics for fiscal year ending June 30, 1897.

The total amount of freight carried during the fiscal year between Wallisville and the mouth was 9,858 tons, of which 79 tons was cotton, 8,747 tons was lumber, 385 tons was coal, 86 tons was stock, and 561 tons was general merchandise.

July 1, 1897, balance unexpended	$7,670.24
June 30, 1898, amount expended during fiscal year	115.00
July 1, 1898, balance unexpended	7,555.24
Amount (estimated) required for completion of existing project	15,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	8,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix V 5.)

6. *Buffalo Bayou, Texas.*—This is a tide-water stream emptying into the San Jacinto River at Lynchburg, about 25 miles below Houston. It is one link in the waterway connecting Houston with Galveston and the Gulf of Mexico, the other links being the San Jacinto River and the ship channel in Galveston Bay. In its natural state the bayou, between Houston and Simms Bayou, a distance of 11 miles, was narrow and tortuous and had a depth in many places of not more than 5 feet; the channel was also obstructed by shoals, logs, and overhanging trees; below Simms Bayou it was wide and deep and required but little or no improvement.

On March 3, 1881, a project was adopted for improving this bayou, the object being to straighten the channel, widen it to 100 feet, deepen it to 12 feet, and to remove such snags, logs, and overhanging trees as were obstructions to navigation. The cost was estimated at $385,299.75. (Annual Report of the Chief of Engineers for 1881, p. 1344 et seq.)

The amount expended to June 30, 1897, was $209,736.38.

This expenditure resulted in an unobstructed channel, 10 feet deep and at least 100 feet wide, from Houston to the mouth.

No work was done during the fiscal year, as Congress by act approved February 1, 1897, indicated a possible intention of amending the project so as to provide a channel not less than 25 feet deep and 100 feet wide from Houston to Galveston, and a harbor at or near Houston 500 feet wide by 25 feet deep.

A survey of the bayou made in March, 1897, gave a least depth in the channel of 9½ feet, except directly at, and for a short distance below, the city of Houston, where considerable shoaling had occurred, due to surface wash and sewage from the city.

On the 26th of July, 1897, a Board met in Houston for the "examination and survey for a water route from the mouth of the jetties at the city of Galveston, Tex., through the ship channel and up Buffalo Bayou *to Houston, Tex.*" The report of this Board is printed in House Doc.

No. 99, Fifty-fifth Congress, second session, and is also submitted herewith as Appendix V 9.

It was the opinion of this Board that the interests involved justify the improvement proposed at a cost of $4,000,000, with cost for maintenance of $100,000 annually.

The sum of $401.26 was expended during the fiscal year in payment of expenses of this Board and for collecting commercial statistics.

The total amount of commerce brought down the bayou during the fiscal year amounted to 160,468 tons, an increase of 31,414 tons over last year. Of this, 128,506 tons was cotton, 12,595 tons was cotton products, 4,758 tons was coal, 4,440 tons was lumber, 7,028 tons was building material, and 3,141 tons was general merchandise.

July 1, 1897, balance unexpended	$19,013.62
June 30, 1898, amount expended during fiscal year	401.26
July 1, 1898, balance unexpended	18,612.36

(See Appendix V 6.)

7. *Brazos River, Texas.*—This improvement is at present limited to that portion of the river lying between Richmond and Velasco, a distance of about 89 miles; its low-water level is affected by the Gulf tide as far up as Bolivar Landing, 40 miles above Velasco. The course of the river is tortuous, and the channel was obstructed by shoals and snags.

The project for improvement was adopted June 3, 1896, and consisted in the removal of snags and overhanging trees. It was estimated that $10,000 would put this portion of the river in a good navigable condition at ordinary stages, and that an annual expenditure of $2,500 would keep it in this condition. (Annual Report of the Chief of Engineers for 1895, p. 1838 et seq.)

No work has been done under this project, owing to the unfavorable stages of water in the river.

The sum of $20 was expended during the fiscal year in payment of account for collecting commercial statistics for fiscal year ending June 30, 1897.

The amount of freight carried between Velasco and Richmond was 15,435 tons, divided as follows: Cotton, 3,785 tons; cotton seed, 8,000 tons; cattle, 2,200 tons; lumber, 500 tons, and general merchandise, 950 tons.

July 1, 1897, balance unexpended	$5,000.00
June 30, 1898, amount expended during fiscal year	20.00
July 1, 1898, balance unexpended	4,980.00
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix V 7.)

SURVEYS MADE IN COMPLIANCE WITH SUNDRY CIVIL ACT OF JUNE 4, 1897, ACT OF FEBRUARY 1, 1897, AND JOINT RESOLUTION OF CONGRESS OF MARCH 5, 1898.

The surveys of the following localities, required by the sundry civil act of June 4, 1897, act of February 1, 1897, and joint resolution of Congress of March 5, 1898, were made, and reports thereon submitted:

1. *Estimates of cost of opening a channel 6 feet in depth through the bar at the mouth of Double Bayou, on the east side of Galveston Bay, Texas.*—March 16, 1898, Capt. C. S. Riché, Corps of Engineers, sub-

mitted report, with map,* required by joint resolution of Congress of March 5, 1898, which authorizes and directs the Secretary of War—

to submit estimates of the cost of opening a channel through the bar at the mouth of Double Bayou, on the east side of Galveston Bay, in the county of Chambers and State of Texas, such channel to be 6 feet deep and 100 feet wide, beginning at a point in Trinity or Galveston Bay where the depth shoals to 6 feet, and creating a channel of this depth to a point of 6 feet depth in Double Bayou, the entire distance not to exceed 1,200 yards, all as shown by maps and surveys made in compliance with the provisions of the river and harbor act of August 17 [18], 1894, and submitted to Congress under date of November 29, 1895; and in making the foregoing estimate the cost shall be estimated for a channel created by permanent walls, also by the process of dredging alone.

It may be proper to remark that the river and harbor act of August 18, 1894, does not provide for a survey of this locality, but a survey of the mouth of this bayou was made in accordance with provisions of the river and harbor act of September 19, 1890, and that is supposed to be the act to which reference was intended in the above joint resolution.

The most recent survey of the bar at the mouth of Double Bayou shows that the distance from a depth of 6 feet in Galveston Bay to a depth of 6 feet in Double Bayou is nearly 2,200 yards, and the estimates submitted are intended to cover the cost of improvement throughout such distance.

The cost of obtaining the required depth, as outlined in the report, is estimated at $20,000, which does not include the cost of maintenance. To protect the clay embankment from wave action $7,000 additional would be necessary; but it is thought that it would be more satisfactory to redredge the channel when it should begin to shoal, and that the deposits on the bank from this second dredging would make it more nearly stable.

The construction of permanent walls, such as are mentioned in the resolution, would necessitate the use of riprap; and even then some dredging would also be required, as it is unlikely that the scour from Double Bayou would produce the desired depth unaided. The cost of the work, if done according to this latter method, is estimated at $80,000.

Captian Riché states that with a Government dredge available of the character proposed for the Houston ship channel by the Board of Engineers in their report contained in House Doc. No. 99, Fifty-fifth Congress, second session, the dredging at Double Bayou could be done in about ten days, at a cost of not over $4,000, and that the cost of maintenance by redredging would be small.

The report was transmitted to Congress and printed in House Doc. No. 387, Fifty-fifth Congress, second session. (See also Appendix V 8.)

2. Examination and survey for a channel from the mouth of the jetties at Galveston, Tex., through the existing ship channel and up Buffalo Bayou to Houston, and for a harbor at or near Houston.—The Board of Officers of the Corps of Engineers constituted to make the examination and report called for in the act of Congress of February 1, 1897, submitted its report of survey November 3, 1897.

The Board is of opinion that in the first division of this water route (through Galveston Bay, including the Morgan Canal) the width of channel should be 150 feet, with slopes such as the material may assume, varying from 1 on 2 to 1 on 4, and that to do this dredging economically and within reasonable time the construction of two large suction dredges is deemed necessary, their estimated cost being $100,000 each. For the second division (from north end of Morgan Canal to Harrisburg) the

*Not printed. Printed in House Doc. No. 387, Fifty-fifth Congress, second session.

Board recommends a width of channel limited to 100 feet. In the third division (between Harrisburg and Houston) the removal of at least one bend by a cut-off will be required, and the straightening and widening of others is proposed. It is also proposed to remove the point just below the San Antonio and Aransas Pass Bridge and to widen the channel at the mouth of White Oak Bayou in Houston.

The cost of this work is estimated by the Board as follows:

First division, including construction of two suction dredges	$1,100,000
Second division	900,000
Third division	1,700,000
Administration and contingencies	300,000
Making a total of	4,000,000

The estimated cost of maintenance is $100,000 annually.

It is the opinion of the Board that the interests involved justify the improvement proposed.

The report was transmitted to Congress and printed in House Doc. No. 99, Fifty-fifth Congress, second session. (See also Appendix V 9.)

3. *Report of Board of Engineers on examination of character and value of improvements made at the Pass of Aransas, Texas, by the Aransas Pass Harbor Company.*—November 22, 1897, the Board of Engineers appointed by the Secretary of War to ascertain the character and value of the improvements made at Aransas Pass, Texas, by the Aransas Pass Harbor Company submitted report required by the sundry civil act of June 4, 1897.

The report was transmitted to Congress and printed in House Doc. No. 137, Fifty-fifth Congress, second session. (See also Appendix V 10.)

The local officer was also charged with the duty of making a survey of *Galveston Bay and Harbor, Texas*, and report of the results will be duly submitted when received.

WESTERN RIVERS.

IMPROVEMENT OF CERTAIN RIVERS AND WATERWAYS IN LOUISIANA, TEXAS, ARKANSAS, AND MISSISSIPPI, TRIBUTARY TO MISSISSIPPI RIVER; WATER GAUGES ON MISSISSIPPI RIVER AND PRINCIPAL TRIBUTARIES.

This district was in the charge of Maj. J. H. Willard, Corps of Engineers. Division Engineeer, Col. Henry M. Robert, Corps of Engineers.

1. *Red River, Louisiana and Arkansas.*—This improvement was begun in 1828 and appropriations aggregating $535,765.50 were made between 1828 and 1852. Between 1841 and 1852 no appropriation was made, and a longer interval elapsed between 1852 and 1872, during which the results of former work were lost.

The present improvement commenced in 1872. At that time the river above Shreveport, La., was closed by the great raft, 32 miles long and increasing with each flood; below Shreveport the river was affected seriously by the gradual enlargement of Tones Bayou outlet, which depleted the main channel and threatened its closure to navigation; the falls at Alexandria were impassable at low stages; snags, stumps, sunken logs, and leaning timber rendered navigation difficult and dangerous the entire length of the river, and more than a hundred steamboat wrecks lay in the channel between Fulton, Ark., and the mouth.

The project adopted in 1872 contemplated removing the raft and closing Tones Bayou. It has been amplified since to include the

removal of jams, snags, wrecks, leaning timber, etc.; opening and enlarging the channel through the falls at Alexandria, deepening shoal places, closing outlets, and fixing caving banks; to improve and keep navigation open from the head of Atchafalaya River, Louisiana, to Fulton, Ark., 508.6 miles. The nature of the work requires that it be continued for many years, and no estimate for completion is given on this account.

The amount expended under this project to June 30, 1897, was $1,324,976.39, with the following results: In the old raft region there flowed in the course marked out for it a broad and deep river, safe at all but the lowest stages, with a channel constantly scouring, the bottom having gone down as much as 15 feet, and the low-water line following it to a certain extent. In addition to opening hundreds of miles of navigable waterway, the removal of the raft drained the great valley of the river and reclaimed thousands of acres of productive lands. Tones Bayou outlet was closing gradually and the main channel below had widened and scoured until it carried the greater portion of the discharge at flood, and navigation of the stretch formerly impaired by the outlet was uninterrupted at the lowest stages. The falls at Alexandria had been made passable the year round, an increase of about two months in the period of navigation. Persistent snagging operations, repeated from time to time, kept the river open, prevented formation of raft, reduced the dangers of navigation to a minimum, and enabled steamboats to make regular trips. At very low stages, say barely a foot above zero on the Shreveport gauge, the river was open to boats of 3 feet draft from the Atchafalaya to Fulton.

The river and harbor acts of July 13, 1892, and August 18, 1894, provided that work under the appropriations of these acts for Red River should be carried out in accordance with the plan of Maj. J. H. Willard, Corps of Engineers, the officer in local charge of the work. Major Willard's plans included the "construction of a substantial system of levees to restrain the greatest floods, either alone or in partnership with the riparian States." The construction of levees was begun by the United States in 1892, in conjunction with the State of Louisiana and local levee districts. In the succeeding three years the United States built, under appropriations of 1892 and 1894, 8¾ miles of new line and repaired and enlarged 5¾ miles of old work, containing 961,499 cubic yards, at a cost of $140,039.33. No levee work has been undertaken by the United States since 1896.

In the fiscal year ending June 30, 1898, snagging operations for general improvement of the river extended from the mouth of Black River, Louisiana, to Fulton, Ark. One snag boat was employed the greater part of the year at this work, and during the period of lowest water two of the largest snag boats of the district worked for the removal of obstructions in the channel. Heavy work was done and great quantities of obstructions were destroyed. The enormous amount of drift carried by Red River and the accumulations of ages, uncovered by scour or disclosed by the shifting of the channel, require that this work be repeated year after year and prompt action to prevent raft formations. Dredging for widening and straightening the cut through the upper falls at Alexandria was resumed July 15 and completed September 29, 1897. In this period 8,089 cubic yards of rock was excavated, completing the project for work at Alexandria and providing a wide and straight cut 6 feet below the low-water line of 1896 (9.3 feet below zero of the Alexandria gauge).

It is recommended that legislative action be taken to transfer the balance of allotment for Little River to the allotment for general improvement. The stretch between Scopini Cut-off and Knox Point, 17½ miles long, called Little River, can be kept in good navigable condition by following the adopted plan of occasional work in connection with the general improvement, or work at any special point when required for the immediate needs of commerce; but as the act of September 19, 1890, directed that the funds should be used in deepening and widening Little River, the transfer can not be made until authorized by Congress.

The estimate of $150,000 here presented is for repairs and additions to plant, surveys, snagging work, and contingencies.

Major Willard, the officer in local charge, submits an additional estimate of $550,000 for the construction of levees. It is respectfully recommended that such an amount as Congress considers proper for expenditure for levee construction as a part of the improvement of the Red River may be appropriated or allotted separately from the appropriation or allotment for other items of improvement.

July 1, 1897, balance unexpended	$100,023.61
June 30, 1898, amount expended during fiscal year	25,497.84
July 1, 1898, balance unexpended	74,525.77
July 1, 1898, outstanding liabilities	36.97
July 1, 1898, balance available	74,488.80
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	150,000.00

(See Appendix W 1.)

2. Red River, above Fulton, Ark.—Before work commenced this part of Red River was obstructed by snags and piles of drift, rendering navigation difficult and hazardous. The project adopted in 1886 contemplated removal of these obstructions, to afford reasonably safe navigation at high stages to the mouth of Kiamichi River, Indian Territory, about 138 miles above Fulton.

The amount expended to June 30, 1897, was $18,059.56. The project of 1886 was completed in 1891, at a cost of $11,774.89, and at the close of that year it was recommended that no further work be done unless a single appropriation of $10,000 should be granted to allow the systematic clearing of the banks and channel without interruption. The small appropriations of 1892 and 1894 were applied to maintenance of the work.

As there is no plant belonging to this work, and as it can not be let by contract advantageously, the officer in charge was authorized to include estimates for it with those for improving Red River, Louisiana and Arkansas, and to continue operations with one of the snag boats belonging to that work. Under this plan the snag boat *Howell* was employed, removing obstructions between Fulton and Spanish Bluff, about 64 miles above, from March 22 to April 10, 1898, having been withdrawn on account of a rapid fall of the upper river.

The commerce of this part of Red River is insignificant at the present time, and the work done has had no perceptible effect upon it. It consists chiefly of logging, with occasional shipments of cotton, seed, and plantation supplies when boats run above Fulton.

July 1, 1897, balance unexpended	$3,940.44
June 30, 1898, amount expended during fiscal year	1,300.90
July 1, 1898, balance unexpended	2,639.54

(See Appendix W 2.)

3. Cypress Bayou, Texas and Louisiana.—Cypress Bayou evidently was an unnavigable stream until the advance of the Red River raft above Shreveport had converted its bottom lands into reservoirs known as Fairy, Sodo, and Cross lakes. Before the work for its improvement between Shreveport, La., and Jefferson, Tex., commenced, navigation was difficult and dangerous by reason of bars and leaning timber in the bayou proper, and snags, stumps, fallen timber, and sunken logs in the channel through the lakes.

The project adopted in 1872 contemplated straightening the channel and dredging bars in Cypress Bayou, to give uniform depth, and the removal of overhanging trees, shore snags, etc., opening and enlarging the entrance of the bayou into the head of Fairy Lake by dredging, removing stumps, snags, sunken logs, and timber from the channel selected down the lakes, and snags, leaning trees, etc., in Twelve-mile Bayou.

The amount expended to June 30, 1897, was $131,133.58. The original project was completed in 1880 at a cost of $94,000, but, owing to the temporary nature of the work, it had to be renewed at intervals. The last work for removal of stumps, snags, and leaning timber was done in 1893. No dredging has been done since 1888. The removal of the Red River raft and the closure of outlets along the right bank of that stream reduced the water supply and caused the lakes to drain more rapidly, shortening the period of navigation. To determine if navigation could be permanently improved by locks or dams, an extended survey was ordered by Congress, which was completed in 1893. The plan for slack-water navigation was not entered upon by Congress, but the river and harbor act of 1894 appropriated $10,000 "for dredging and removing obstructions and straightening channel between Jefferson, Tex., and Shreveport, La.," and the act of 1896 provided $5,000 "for continuing improvement." The project for expenditure of these amounts was approved June 14, 1897.

An elevator dredge, belonging to the plant of this district, was towed from Vicksburg, Miss., and delivered at Shreveport, La., July 5, 1897, ready to cross Albany Flats on the first sufficiently high stage and begin work under the project; but during the ensuing twelve months there was no stage of water high enough for the purpose. In the twenty-six years in which readings of the Shreveport gauge have been maintained, this is the first time that twelve months has elapsed without a rise sufficient to put the dredge across the flats, with one exception—the fiscal year 1894–95—which, however, was followed by a flood stage in July, 1895. In January, 1898, after a rise of Red River had set in and there was reasonable probability of getting the dredge from Shreveport into Sodo Lake, the small U. S. snag boat *Columbia* was added to the plant at Shreveport, as a tender for the dredge, and since then necessary repairs and alterations of the boats were made. If there should be no high stage in July, the gauge records show that none may be expected before next January, and, in such event, it is proposed to send a party over the route at low water, to blow up stumps, cut leaning timber, etc.

The work done since 1886 had no permanent effect upon the commerce between Jefferson and Shreveport, which dwindled to insignificance.

The maintenance of the water route doubtless would act more as a check upon freight rates than as a means of transportation.

July 1, 1897, balance unexpended	$14,567.75
June 30, 1898, amount expended during fiscal year	3,525.57
July 1, 1898, balance unexpended	11,042.18
July 1, 1898, outstanding liabilities	19.11
July 1, 1898, balance available	11,023.07

(See Appendix W 3.)

4. Ouachita and Black rivers, Arkansas and Louisiana.—The improvement of Ouachita River was commenced in 1871. Black River, 56 miles long, connecting Ouachita with Red River, was added under the same head of appropriation by act of 1884. The original project contemplated temporary improvement of the Ouachita from Arkadelphia, Ark., to Trinity, La., by removal of snags, etc., and dredging the worst bars. In 1872 a project for improvement by locks and dams was entered upon, but it was abandoned in 1874 for various reasons, the chief one being that the locks would be idle at the time intended for use until a permanent improvement should be obtained at the mouth of Red River. The project under which work has continued since 1874 contemplates the removal of snags, logs, wrecks, leaning timber, etc., below Camden, Ark., 350 miles above the mouth of Black River, and the improvement of shoal places by dams and dredging. No estimate of cost is given, as the nature of the work requires that it be continuous.

The total amount expended to June 30, 1897, was $455,687.05. The amount expended under the project of 1874 was $324,330.17. The iron-hull snag boat *Wagner* was purchased for the work in 1875 and the small wooden snag boat *Columbia* in 1888. Operations were carried on whenever funds were available and conditions favorable, and consisted chiefly in removing snags, logs, wrecks, and tree slides in the channel and leaning timber along the banks. An increased depth was gained at some shoals in the upper river by wing dams of stone and brush, the temporary effect of which, however, has been lost. Catahoula Shoals, a rock and gravel bar 20 miles above Trinity, formerly much complained of by steamboat men, were improved permanently by dredging, etc., finished in 1895. To comply with requirement of the act of 1894, a survey was commenced for the purpose of preparing plans and estimates for improvement by locks and dams.

During the period of low water in the fiscal year ending June 30, 1898, the snag boat *Wagner* worked from Rutland Bar to mouth of Black River, a distance of 124 miles, and a party equipped with tools and explosives worked from Camden, Ark., to Monroe, La., 167¼ miles, removing obstructions from the channel and banks. The stretch of 50 miles below Monroe to Rutland Bar was the only part of the river in which nothing was done.

Office and field work of the survey was continued during the year with good results, and while the information acquired is sufficient to warrant the belief that a slack-water system between Trinity, La., and Camden, Ark., 354 miles, to give 6½ feet depth, is feasible, it is not deemed sufficient for the preparation of final plans and estimates for a project for so large an expenditure as would be required, and which may involve the question of damages to overflowed lands. It is desired, therefore, to make the survey so complete that there shall be no doubt about final conclusions, whether favorable or adverse to locks and dams.

July 1, 1897, balance unexpended	$46,812.95
June 30, 1898, amount expended during fiscal year	26,064.63
July 1, 1898, balance unexpended	20,748.32
July 1, 1898, outstanding liabilities	61.19
July 1, 1898, balance available	20,687.13
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	70,000.00

(See Appendix W 4.)

5. *Bayou Bartholomew, Louisiana and Arkansas.*—Before this improvement was commenced by the United States, the bayou was so obstructed by snags, logs, wrecks, leaning timber, etc., that it was navigable for light-draft boats at high stages only, or for about three months in the year, and even during that short period the passage was slow, difficult, and dangerous.

The project entered upon in 1881 contemplated removing the obstructions to give safe navigation and extend the period thereof. The estimated cost of two seasons' work between Baxter, Ark., and the mouth, about 150 miles, was $26,862, but the appropriations did not permit the thorough work contemplated. If funds had been provided, the work probably could have been completed as planned, but the addition of new obstructions each year would have necessitated small appropriations for maintenance.

The amount expended in the sixteen years ending June 30, 1897, was $45,873.53. The work of 1897 practically completed the project for removing obstructions to navigation between the mouth of the bayou and McComb Landing, the present head of navigation, about 125 miles above, there being no demand for navigation from McComb Landing to Baxter at present. The work since 1881 resulted in safer navigation, increasing the period to about six months of the year, enabling larger boats to make trips in half the time formerly required, and reducing freight rates about one-half.

Drift, caving and sliding banks, and the rapid growth of vegetation constantly add new obstructions, which accumulate more rapidly and become more difficult to remove each year. The annual cost of maintaining unobstructed navigation at stages on which steamboats can run is estimated at $2,500. No provision for maintenance was made during the fiscal year ending June 30, 1898, and the work required during the ensuing year will be much greater and the cost correspondingly increased.

The small balance available July 1, 1897, was expended in November and December, during the period of lowest water, for removing and destroying obstructions from the mouth up to Point Pleasant, La., a distance of about 38 miles.

July 1, 1897, balance unexpended	$1,126.47
June 30, 1898, amount expended during fiscal year	1,126.47
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	5,000.00

(See Appendix W 5.)

6. *Bœuf River, Louisiana.*—The improvement of this stream was undertaken by the State of Louisiana more than half a century ago. Before work commenced by the United States, it was navigable to Point

Jefferson, La., at high water, but passage was difficult and dangerous on account of overhanging timber, snags, and logs.

The project adopted in 1881 contemplated removing obstructions to afford safe navigation at high stages from the mouth to Wallace Landing, about 152 miles above. The closure of three outlets near Point Jefferson, to confine the flow to the main channel, was added to the project in 1886.

The amount expended to June 30, 1897, was $46,671.54.

The project for removing obstructions to give safe navigation at high stages was completed in 1896, but the work is not permanent, new obstructions being constantly added by drift, sliding and caving banks, and the rapid growth of timber along the banks.

The three outlets near Point Jefferson were closed as securely as possible with the funds available in 1887–88, and their closure gave immediate benefit to navigation by confining the flow to its natural course and scouring the bars below. The dams were destroyed during the overflow from the Mississippi River in 1890, caused by breaks in the Arkansas levees near the head waters of Bœuf River, and funds have not been provided for their restoration. Soundings in 1896 showed a very considerable shoaling below the outlets. The estimated cost of the work required for closing them substantially is $30,000. The appropriation of $6,000 by act of June 3, 1896, has been held in abeyance for the reason that it was thought to be impracticable to advantageously apply so small a sum to the work required to be done.

No work was done during the fiscal year ending June 30, 1898, but it is proposed to send a small party with tools and explosives over the river during the period of low water to remove and destroy obstructions added since the last work was done.

July 1, 1897, balance unexpended	$8,328.46
June 30, 1898, amount expended during fiscal year	270.00
July 1, 1898, balance unexpended	8,058.46
July 1, 1898, outstanding liabilities	.86
July 1, 1898, balance available	8,057.60
Amount (estimated) required for completion of existing project	24,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, including maintenance	12,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix W 6.)

7. *Tensas River and Bayou Maçon, Louisiana.*—These streams were navigable at high stages before work was undertaken by the United States, but passage of steamboats was difficult and dangerous on account of leaning timber and snags, logs, etc., in the channel. The project for improving Tensas River, adopted in 1881, contemplated removing obstructions between the mouth and Dallas, about 134 miles above, at an estimated cost of $23,000. Bayou Maçon, the principal commercial branch, was added under the same head of appropriation by act of 1884, and the project contemplated the same class of work between its junction with Tensas River and Floyd, about 98 miles above, at an estimated cost of $17,000.

The amount expended to June 30, 1897, was $31,019.18, of which sum $10,623.50 was applied to Tensas River and $20,395.68 to Bayou Maçon. With these expenditures Bayou Maçon to Floyd, and Tensas River to Westwood Place, about 75 miles above its mouth, were put in fairly good navigable condition at medium and high stages for the time.

In the fiscal year ending June 30, 1898, during the period of lowest water, in September and October, a party with tools and explosives worked over lower Tensas River, removing all snags, logs, stumps, and trees obstructing navigation below mouth of Bayou Maçon, and a party equipped with tools and explosives commenced work at Floyd June 27, 1898, for the removal of obstructions to navigation of Bayou Maçon, and will continue downstream until the available funds are exhausted.

The original plans contemplated an expenditure of $40,000 for thorough work in one low-water season. With the small appropriations made at intervals, operations have dragged along over a period of seventeen years, are by no means complete, and new obstructions are added each year.

July 1, 1897, balance unexpended	$4,980.82
June 30, 1898, amount expended during fiscal year	2,115.78
July 1, 1898, balance unexpended	2,865.04
Amount (estimated) required for completion of existing project	4,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	4,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix W 7.)

8. *Yazoo River, Mississippi.*—Prior to improvement, navigation of this river was obstructed by wrecks of gunboats, steamers, etc., sunk to prevent passage during the war of the rebellion, and by a great number of snags, stumps, tree slides, and sunken logs in the channel, and a heavy growth of leaning timber along the banks.

Nine wrecks were removed by contract in 1873–74, and the latter year a project was made to clear the river thoroughly of obstructions then existing in a period of four years, at a cost of $120,000, annual appropriations to be made thereafter for maintenance of the work. The appropriations made were not sufficient to carry out this plan, and work has continued from time to time under a project for the removal of wrecks, snags, logs, leaning timber, etc., so far as the funds provided will permit. Floods, sliding and caving banks, leaning timber, and the rapid growth of vegetation along an alluvial stream of this character add new obstructions to navigation continually, and snagging operations, etc., should continue from year to year in the interest of safe and uninterrupted navigation.

The amount expended to June 30, 1897, was $247,363.13. The results of the work were marked. The large number of wrecks that blocked the channel at low stages and limited the period of navigation had been removed so as to present no obstruction, and the removal of snags, logs, leaning timber, etc., repeated from time to time, opened and maintained steamboat navigation from mouth to head of the river the year round.

In the fiscal year ending June 30, 1898, the U. S. snag boat *Meigs* worked from mouth to head of river, July 26 to September 17, and was withdrawn the latter date on account of proximity of an epidemic of yellow fever. In January the same boat made a patrol of the entire river. As the stage of low water was approaching, preparations were made in June, 1898, for work between Burtonia, on the river side of Honey Island, and Yazoo City.

Work in Yazoo River and its tributaries could be carried on with greatest economy and the best results obtained if the streams were grouped as a system under one general head, and with this view the

appended estimate is made. If sufficient plant is acquired, and the work thoroughly done, the cost of maintenance should decrease each year.

The river and harbor act of August 11, 1888, contained an appropriation of $32,000 for improving Yazoo River, and provided that of this sum $8,000 shall be used for constructing a pumping dredge boat. An unexpended balance of $2,026.14 of this allotment for constructing the pumping dredge remains unexpended and is not required for the purpose named in the act, and it is recommended that the assent of Congress be given for the transfer of this balance to the allotment for general improvement of the river.

The acts of August 18, 1894, and June 3, 1896, each provides, in the item of appropriation for Yazoo River, for application of a portion of the funds provided to removing bar at Yazoo City. This provision was not inserted in the acts upon recommendation of this office, and there appears to be no sufficient reason why the bar mentioned should be removed. In fact, the officer in charge states that the survey made in June, 1896, confirms his opinion that removal of the bar at Yazoo City would impair the navigation of the river at and above the bar. For the above reasons, and for the further reason stated by Major Willard that the sentiment of such citizens as expressed themselves on the subject was decidedly adverse to the removal of the bar on the city front, I recommend that the provisions of the acts of 1894 and 1896, touching removal of this bar, be repealed.

July 1, 1897, balance unexpended	$27,636.87
June 30, 1898, amount expended during fiscal year	10,000.80
July 1, 1898, balance unexpended	17,636.07
July 1, 1898, outstanding liabilities	1.01
July 1, 1898, balance available	17,635.06
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	50,000.00

(See Appendix W 8.)

9. Mouth of Yazoo River and harbor at Vicksburg, Miss.—The shifting bar at mouth of Yazoo River is the most serious obstruction to navigation of that river and its tributaries, a system of about 800 miles of navigable waterways. At low stages steamboats are prevented from entering or leaving the river without lightering, and frequently navigation across the bar is closed entirely at the busiest season of the year. A survey with a view to giving free passage the year round for vessels engaged in navigation of the river was directed by river and harbor act of 1890, and the plan based thereon contemplated making a new mouth or outlet for the river from the former mouth of Yazoo, on Old River, about 9.8 miles above present mouth, through the deep water in Old River, across the neck of low land between Long and Barnett lakes to Lake Centennial, and thence down Lake Centennial, around the head of De Soto Island and along the front of Vicksburg, entering Mississippi River on the channel side at Kleinston Landing. Vicksburg Harbor is that part of the old channel of the Mississippi cut off in 1876 and now known as Lake Centennial, in front of the city and extending down to Kleinston.

The original estimate of cost of the work required was $1,500,000, but was revised in 1893 and reduced to $1,200,000, upon a basis of completion in three years. The project was entered upon by the

United States in the river and harbor act of 1892, which provided $75,000 for beginning work, and the act of 1894 contained appropriations of $265,000 for continuing the improvement. The sundry civil act of June 4, 1897, appropriated $350,000 for the work, making the total sum appropriated $690,000.

The river and harbor act of June 3, 1896, appropriated no money, but provided for completing the work, as follows:

Improving mouth of Yazoo River and harbor of Vicksburg, Mississippi: For the purpose of completing the project of improvement as heretofore adopted and entered upon, in addition to expending the balance on hand, contracts may be entered into by the Secretary of War for such materials and work as may be necessary to complete the same, or said materials may be purchased and work may be done otherwise than by contract to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate eight hundred and sixty thousand dollars, exclusive of the amount heretofore appropriated.

The amount expended to June 30, 1897, was $165,884.65. The preliminary surveys and maps were finished. A final line had been selected for the excavation between Old River and Lake Centennial, borings had been made, and character of material determined. Property lines were traced on the ground, and the limits of right of way to be acquired ascertained and marked. Abstracts of title were prepared from the county records, and the Attorney-General having given opinions that titles were valid, definite offers were obtained from the various owners and the purchases made under authority of the Secretary of War, aggregating 1,155.54 acres, which cost $34,254.68, or an average price of $29.64 per acre. Jurisdiction over these lands was ceded to the United States by the State of Mississippi. A base for future levels along the whole route from Old River to Kleinston was measured with steel tape, and reference points, marked with vitrified pipes filled with cement, were set every 164 feet. Between Old River and Lake Centennial the pipes were set along both sides of the route 328 feet from the center line. The entire route from Old River to Kleinston was cleared and grubbed. A considerable amount of the timber felled was cribbed and towed into Lake Centennial, to be sunk as a foundation for the dam across the west arm. All logs, stumps, and débris that could not be towed off the right of way were piled and burned. A ditch was cut to drain Barnett Lake, which lowered the surface sufficiently to remove stumps in the lake bed. It having been considered advisable to remove by scrapers a part of the land cut near both ends, where the ground was highest, so that dredges could operate over the elevated portions at high stages, withdrawing to lower lands as the water fell, and also to permit towing logs from the right of way, 277,709 cubic yards of earth was removed by contract, and the material placed in continuous embankments along both sides of the route.

In the fiscal year ending June 30, 1898, a ditch was dug to drain flood water ponded by the embankment along the canal; a resurvey at present mouth of Yazoo was made to determine changes at that locality; elevations of flood marks of 1897 were determined by levels; the road along the canal was repaired and put in passable condition; cross sections of canal site were made; reference signs damaged by flood and drift were repaired; and proposed levee lines were partly located and mapped.

The project for excavation from Old River to the Mississippi under the continuing-contract system was authorized by the War Department February 1, 1898, but has been delayed until the amount of levee work could be ascertained. The levee commission having failed to organize under the State law, it is proposed to leave that part of the work in abeyance for the present, and to invite bids by public adver-

tisement at an early date for the excavation required; no work to be undertaken unless the bids received show that the project can be completed within the limit fixed by law.

The condition of the work at end of the year is summarized as follows:

Work done—		
Surveys and mapping.		
Reference signs erected		317
Land purchased	acres..	1,155.54
Timber land cleared	do...	166.20
Timber land grubbed	do...	183.47
Right of way freed of logs and stumps—removed and destroyed	do...	98.84
Excavation	cubic yards..	277,709
Drains and ditches	do...	8,056
Approximate work to be done—		
Excavation	cubic yards..	7,500,00
Levees	do...	65,000
Dam across west arm of Lake Centennial	do...	3,008,400
July 1, 1897, balance unexpended		$524,151.35
June 30, 1898, amount expended during fiscal year		9,398.96
July 1, 1898, balance unexpended		514,752.39
July 1, 1898, outstanding liabilities		59.65
July 1, 1898, balance available		514,692.74
Amount (estimated) required for completion of existing project		510,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900		510,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix W 9.)

10. Tallahatchie River, Mississippi.—Before this work was undertaken the river was navigable to Sharkey, about 65 miles above the mouth, for six months of the year, but passage for steamboats was difficult and dangerous. Above Sharkey a heavy growth of leaning timber rendered the stream nearly impassable at all stages. The project contemplated removing the wreck of the ocean steamship *Star of the West*, sunk during the war of the rebellion 8 miles above the mouth, and snags, sunken logs, leaning timber, etc., to give ease and safety to navigation from head of Yazoo River to mouth of the Coldwater, about 100 miles above. It was proposed to do the work then required in two seasons, at a cost of $40,000.

The improvement commenced in 1879, and the expenditures during the eighteen years to June 30, 1897, aggregated $49,975.36; but of this sum $10,000 was applied to the stretch above mouth of Coldwater to Batesville, in accordance with provisions of the acts of 1880, 1881, and 1882. The work below the mouth of Coldwater River could not be done thoroughly, as planned in the project of 1879, because the appropriations permitted expenditures averaging only $2,131 a year.

The intermittent work, however, benefited navigation considerably, enabling steamboats to run to Sharkey the year round and to Coldwater River at high stages. In 1896 leaning trees and channel obstructions above Sharkey to Coldwater River were removed so far as practicable with funds available, and the work enabled small boats to run that stretch with safety at much lower stages. In 1897 work was carried from Sharkey to the mouth, and that part of the river put in good navigable condition for the time.

In the fiscal year ending June 30, 1898, a snag boat was employed for a few days removing tree slides, snags, etc., between the mouth and Philipp, where the Yazoo and Mississippi Valley Railroad crosses the

stream, that being all that could be done with the limited amount available.

New obstructions are brought into the river every year by drift and sliding and caving banks, and the shifting and scouring of the channel exposes snags and logs embedded in the bottom from time to time, or lodges them upon bars. An appropriation sufficient to permit the systematic clearing of the banks, in addition to snagging operations, could be expended profitably in one season of low water, would result in lasting benefit to navigation, and but small amounts would be needed for maintenance.

July 1, 1897, balance unexpended	$524.64
June 30, 1898, amount expended during fiscal year	524.64
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	5,000.00

(See Appendix W 10.)

11. Big Sunflower River, Mississippi.—Before the improvement of this river commenced, navigation was badly obstructed by snags, sunken logs, leaning timber, sand bars, and shoals. The low-water channel at many places was so filled with logs as to give no greater depth than 18 inches, and so narrow as to afford passage for the smallest boats only. Leaning timber obstructed navigation at all stages, and Oliphant Bar, extending from the mouth upstream 15 miles, and Muscle Shoals, 5 miles long, beginning about 30 miles above the mouth, had depths at low water ranging from 17 to 24 inches.

The project entered upon in 1879 contemplated work during three to four consecutive seasons of low water for the removal of leaning timber and obstructions in the channel and the building of wing dams to scour a depth of about 40 inches at the bars, at a probable cost of $66,000, operations to extend to Clarksdale, about 180 miles above the mouth. In the first three years, 1879–1882, $37,000 was appropriated, and fairly good progress was made. In the succeeding sixteen years only $35,000 has been provided for continuing the improvement. New obstructions were being added continually and prevented further advancement.

The amount expended to June 30, 1897, was $67,000. Before work commenced, there was navigation for light boats about six months of the year. The work done enabled boats to run to Woodburn, 77 miles above the mouth, the year round, and at ordinary stages to make the trip in little more than half the time formerly required. Passage was difficult and dangerous at low stages. Faisonia, about 100 miles above the mouth, was considered the head of navigation. Freight rates were said to have been reduced 50 per cent.

In the fiscal year ending June 30, 1898, a party with tools, explosives, etc., worked, during the period of lowest water, from the mouth upstream about 80 miles, removing snags, logs, stumps, leaning trees, etc., obstructing navigation. So far as it extended, this work put the river in good navigable condition, and after the local quarantine on account of yellow fever was raised the small steamboats used in this river at low stages followed the party as operations progressed upstream. Above the point where work stopped, however, the river is much obstructed, and should receive early attention in the interest of safe navigation.

As new obstructions are added from time to time, it is impracticable to make a definite estimate for completing the project, but an expenditure of $20,000 in one or two low-water seasons will result in greater

benefit to navigation and in work of a more lasting character than in the past.

July 1, 1897, balance unexpended	$5,000.00
June 30, 1898, amount expended during fiscal year	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	10,000.00

(See Appendix W 11.)

12. Water gauges on the Mississippi River and its principal tributaries.—These gauges were designed to secure information from continuous records, with a view to protecting alluvial lands against overflow, improving navigation, and giving correct reports of the stages of water for the benefit of river men and planters. Their establishment and the maintenance of daily observations were enjoined upon the Secretary of War by joint resolution of Congress approved February 21, 1871 (Stat. L., vol. 16, p. 598). Section 6 of the river and harbor act of 1888 provided a permanent-indefinite appropriation for the purpose of securing uninterrupted gauging.

The amount expended to June 30, 1897, was $119,587.88. The 17 gauges ordered by the resolution of February, 1871, were established the latter part of that year, except the one at Carrollton, La., established in January, 1872. Seven additional gauges have been established and two discontinued, and there are now 22 gauges maintained. The service had been improved materially. In 1881 bulletins were erected at the stations on the Mississippi for the purpose of giving passing steamboats the stage of water, and to indicate whether rising, stationary, or falling. In 1890 they were replaced by larger bulletins and the old ones used for extending the service to the tributaries. Since February 1, 1887, the gauges have been read and bulletins posted twice a day. The readings have been published by the Mississippi River Commission to end of the calendar year 1897.

The yearly expenses of this work, if properly maintained, vary considerably, and extraordinary repairs of the gauges and bulletins, frequent inspections, etc., may increase the cost for one year to double that of the year preceding or following it. At the present time a large number of the gauges need extensive repairs, and the bulletins on the Mississippi, built in 1890, are worn out and should be replaced by a more permanent type. Four new gauges were added in 1890, increasing the cost of observations alone by the sum of $540 per annum, with additional charges for inspections and repairs.

Under existing decisions, a fiscal year appropriation of not to exceed $6,000 is provided, of which $500 may be allotted under the law for discharge measurements at St. Paul, Minn. The amount is not sufficient for proper maintenance of the present service.

July 1, 1897, amount allotted for fiscal year ending June 30, 1898	$5,500.00
June 30, 1898, amount expended during fiscal year	5,498.39
July 1, 1898, balance unexpended	1.61
July 1, 1898, outstanding liabilities	1.61
July 1, 1898, amount allotted for fiscal year ending June 30, 1899	6,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	9,600.00

(See Appendix W 12.)

Major Willard was also charged with the duty of making a survey of *Ouachita River, Arkansas and Louisiana, for improvement by locks and dams*, and report of the results will be duly submitted when received.

IMPROVEMENT OF ARKANSAS RIVER AND OF CERTAIN RIVERS IN ARKANSAS AND MISSOURI.

This district was in the charge of Capt. W. L. Sibert, Corps of Engineers. Division Engineer, Col. Henry M. Robert, Corps of Engineers.

1. Removing obstructions in Arkansas River, Arkansas and Kansas.—This river was, previous to improvement, seriously obstructed by snags, overhanging timber, reefs, and bars.

The original project under this head was to raise and destroy snags, cut overhanging timber, remove bowlders and reefs by blasting and dredging, and cut out sand bars by temporary wing dams. To this was later added the survey of the river, with the view to permanent improvement.

Since appropriations for permanent improvement were made, blasting, dredging, and dams have been omitted from the project, leaving customary snagging operations only.

On this work there had been expended to June 30, 1897, $851,210.87.

The evidence of pilots and masters is that in the permanent reaches of the river the condition has been materially improved; in the shifting channels the relief is only temporary, and the obstructions to navigation are still numerous and dangerous. The best illustration of the condition is the fact that steamboats have to pay 18 per cent per annum for insurance.

During the fiscal year ending June 30, 1898, a snag boat worked over the river below Pinebluff three times, maintaining a safe channel in that part of the river.

Snagging operations on this stream are a continuous necessity.

The two snag boats, *Wichita* and *Beauregard*, belonging to this appropriation, are in bad repair. A new snag boat, which will cost about $30,000, is needed for this work. The hull of the *Beauregard* is rapidly deteriorating, and should be replaced by a new one, at a probable cost of $8,000.

The commerce of the stream consists of plantation products and supplies, timber and cooper stuffs, and general merchandise. Tabulation showing yearly tonnage and values is given under the heading "Arkansas River, Arkansas."

July 1, 1897, balance unexpended	$18,072.59
June 30, 1898, amount expended during fiscal year	10,417.20
July 1, 1898, balance unexpended	7,655.39
Amount that can be profitably expended in fiscal year ending June 30, 1900. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	25,000.00

(See Appendix X 1.)

2. Arkansas River, Arkansas.—In addition to such obstructions as snags, the channel of this river was for nearly all of its length of a shifting character and was obstructed by sand bars fed by caving banks. In the upper reaches there were some reefs of rock.

Prior to 1886 works upon this river were special improvements of detached reaches, generally with immediate reference to confining the channel to drawspans of bridges or the water fronts of towns, and to the improvement of some especially difficult crossing.

The project and estimate for the improvement of the whole river was made in three parts: Annual Report, Chief of Engineers, 1885, page 1603, for improving Arkansas River from Little Rock to mouth, $2,538,544; Annual Report, Chief of Engineers, 1888, page 1386, for improvement between Fort Gibson and Little Rock, at a cost of $1,307,935, and House Ex. Doc. No. 90, Forty-ninth Congress, first session, for improvement between Arkansas City, Kans., and Fort Gibson, $1,696,900. The act of August 11, 1888, adopts a project for improving Arkansas River from Wichita, Kans., to the mouth, mentioning distinctly the plans, which include the estimates from Little Rock to the mouth and from Fort Gibson to Arkansas City, Kans., and by implication approves the estimate for improvement between Little Rock and Fort Gibson. No estimate has ever been made or approved for the improvement of the river between Arkansas City, Kans., and Wichita, Kans.

The estimates for improving the reach from Little Rock to the mouth and from Little Rock to Fort Gibson were based upon an improvement by permeable dikes alone, and by dredging, whereas the act of August 11, 1888, authorizes the application of any of the methods set forth in the projects for the three reaches at such points between Wichita, Kans., and the navigable mouth of the Arkansas River as the Secretary of War may direct.

The application of those approved methods that have been most effective will largely increase the estimate for improving the reaches between Fort Gibson and Little Rock and between Little Rock and the mouth. Under date of August 29, 1896, authority was granted for calling the estimate for completing the project for improving Arkansas River from Wichita, Kans., to the mouth "indefinite."

The present project is to remove rock and gravel reefs by blasting and dredging, to contract the channel by dikes or dams, permeable or solid, of such construction as the local conditions require, and to hold the channel so obtained by revetment, where necessary, from Wichita, Kans., to the mouth, the object being to secure a channel not less than 6 feet in depth from Little Rock to Mississippi River, via White River Cut-off, and not less than 2 feet in depth above Little Rock, Ark.

From the appropriations made for the improvement of this river there had been expended to June 30, 1897, $159,500 on special works, $19,550.66 on removing obstructions, and $904,803.95 on the present project, making the total expenditure to that date $1,083,854.61.

The special work and some of that done on the project before July 1, 1894, was for local improvement, such as the construction of dikes at Dardanelle to remove a bar from the front of the town, the construction of revetments and dikes to stop caving along the town front of Pinebluff, the construction of dikes to maintain the channel through the drawspans of bridges at Fort Smith, Vanburen, Little Rock, and Rob Roy, and the construction of dikes at a few of the troublesome crossings. Since July 1, 1894, the work on the project has been that of repairing the works previously built and making the improvement continuous from Little Rock to a point 20 miles above. To June 30, 1897, the channel had been maintained through the drawspans of all bridges crossing the river, caving along the town front of Pinebluff had been stopped, and in the 20-mile reach above Little Rock indications of material improvement were shown.

The work of the past fiscal year has been that of repairing the works at Pinebluff, building temporary structures at eight crossings below Pinebluff, and completing the works in the 20-mile reach above Little Rock. During the year navigation was possible in the latter reach

when it was not possible in the reaches above or below, but a navigable channel throughout the year was not maintained. The condition of the other works was practically the same as it was June 30, 1897. The spring flood of the Arkansas River did much damage to the works, and the effect on the channel June 30, 1898, is not yet known, the river not having fallen to a low stage. This flood shows that the high as well as the low water flow of the river must be controlled in order to permanently improve the river and hold the work done. The experience of the last few years seems to show that it will cost $35,000 per mile to do this above Little Rock, and $50,000 per mile below Little Rock, and that the expenditure of from $50,000 to $125,000 per year in attempting to improve 773 miles of such river is an uneconomical expenditure of money.

The plant now available for this appropriation is small, and before work is resumed it will be necessary to increase it by replacing that which has become unserviceable.

The commerce of this stream is made up of plantation products and supplies, timber and cooper stuffs, and general merchandise. For several years no regular packet has operated between Little Rock and Pinebluff, but this year the line has been revived and weekly trips are made when stage of water permits.

Commercial statistics.

Year.	Value.	Tons.	Year.	Value.	Tons.
1894	$2,846,395	63,563	1897	$1,657,218	66,077
1895	2,380,420	50,498	1898	1,626,756	58,578
1896	2,408,720	54,261			

July 1, 1897, balance unexpended		$49,645.39
June 30, 1898, amount expended during fiscal year	$40,963.54	
Amount refunded	183.60	
		49,779.94
July 1, 1898, balance unexpended		*8,865.45
July 1, 1898, outstanding liabilities		350.00
July 1, 1898, balance available		8,515.45

Amount (estimated) required for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1900	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix X 2.)

3. White River, Arkansas.—Before improvement this river was seriously obstructed by snags and overhanging timber for its entire length, and by shoals in the upper part of the stream.

The project of improvement includes the usual snagging operations, blasting, and dredging, and the contraction of the channel by wing dams.

From appropriations for this river and for separate reaches of it there was expended to June 30, 1897, $342,505.03. Of this, $349.41 was expended in snagging operations on Cache River.

The condition of the improvement June 30, 1897, was such as to allow 3-foot navigation, at ordinary low water, from the mouth of the river to

*$2,891.06 for removing obstructions; $5,974.39 for project.

Jacksonport (264 miles); 22-inch navigation, at ordinary low water, between Jacksonport and Batesville, and 10-inch navigation above Batesville.

The operations of this year consist of snagging operations below Batesville and dredging between the mouth of Black River and Batesville. By the snagging operations the 3-foot channel was preserved in the lower river, and by the dredging it was extended to Batesville (302 miles above the mouth). There is no steamboat navigation above Batesville when the river is at or near low water.

Snagging operations on Cache River made rafting possible at a stage 3 feet lower than that required before the work was done. There is no navigation at low water, the depths over the shoals being only 6 to 8 inches at that time.

The commerce of White River is made up of shipments of plantation products and supplies, timber, and miscellaneous freights; that of Cache River is made up principally of timber.

Commercial statistics, White River, Arkansas, year ending May 31.

Year.	Value.	Tons.	Year.	Value.	Tons.
1894	$1,043,438	45,793	1897	$2,435,814	78,962
1895	2,494,377	73,759	1898	1,415,013	102,337
1896	2,056,991	74,882			

Commercial statistics, Cache River, Arkansas, year ending May 31.

Year.	Value.	Tons.	Year.	Value.	Tons.
1895	$20,748	12,603	1897	$108,460	34,990
1896	62,483	20,748	1898	36,635	10,193

July 1, 1897, balance unexpended	$27,494.97
June 30, 1898, amount expended during fiscal year	17,825.52
July 1, 1898, balance unexpended	*9,669.45
July 1, 1898, outstanding liabilities	198.75
July 1, 1898, balance available	9,470.70
Amount (estimated) required for completion of existing project	14,815.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	14,815.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix X 3.)

4. Black River, Arkansas and Missouri.—Before any improvements were made the obstructions to navigation were snags, logs, and leaning timber throughout the entire length of the river, to which were added shoals in the upper reaches. Pocahontas was considered the head of practical navigation, and rafting was impossible above the Arkansas and Missouri State line.

The original, as well as the present, project is for the usual snagging operations, the closing of chutes, and the construction of wing dams.

From the separate appropriations for this river there had been expended to June 30, 1897, $97,295.16. This expenditure had made 3-foot naviga-

*$378.84 for removing obstructions in Cache River; $9,290.61 for White River project.

tion practicable from the mouth to the mouth of Current River (146 miles) during ordinary low water, and had made the river from the mouth of Current River to Poplar Bluff (123 miles) navigable by boats of 2-foot draft for about ten months each year.

During the past fiscal year a channel was dredged through Julia Dean Bar, the dam across Dan River at the head of Big Island was built, and a small amount of snagging done below the mouth of Current River. All this work may properly be classed as maintenance. Much rafting is done on this river, sunken saw logs and drift accumulate rapidly, and snagging operations can be increased with profit.

The channel depths at ordinary low water, June 30, 1898, are 3 feet below the mouth of Current River and 2 feet above that point.

Commercial statistics, year ending May 31.

Year.	Value.	Tons.	Year.	Value.	Tons.
1894	$956,982	87,536	1897	$1,704,799	111,611
1895	1,085,415	132,433	1898	788,640	115,612
1896	891,437	111,278			

July 1, 1897, balance unexpended	$5,204.84
June 30, 1898, amount expended during fiscal year	3,958.04
July 1, 1898, balance unexpended	1,246.80
Amount (estimated) required for work annually	8,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	8,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix X 4.)

5. *Current River, Arkansas and Missouri.*—The original condition of this stream was such that no steamboat navigation above the mouth of Little Black River was attempted except when the river was at high stages. Below Little Black River navigation was suspended when the river was below medium stage. The natural depths were not available on account of snags and leaning timber.

The project provides for improving the channel to Vanburen, Mo. (95 miles), by the usual snagging operations and by contracting the channel at the worst shoals by wing dams.

The amount expended on the improvement of this river to June 30, 1897, was $14,681.48.

The condition of the improvement on June 30, 1897, was such as to allow boats of 3½ feet draft to navigate the river to Johnsons Landing at any time, and to navigate to the mouth of Little Black River on a 2-foot rise. At medium stages navigation to Current View (near the State line) was possible, and rafts could be run from above Doniphan, Mo.

During the past fiscal year little work was done; only such snags as were in the channel below the mouth of Little Black River were removed and some of the overhanging timber was cut.

Since suspension of work freshets have brought many obstructions into the channel, and it is in bad condition, especially so between Current View and Little Black River.

The amount estimated for completion of existing project has been appropriated. Improvements by snagging operations are temporary. Two thousand dollars will be required each year to maintain the present channel.

Commercial statistics, year ending May 31.

Year.	Value.	Tons.	Year.	Value.	Tons.
1895	$362,447	31,205	1897	$581,528	17,078
1896	227,291	29,867	1898	306,216	52,417

July 1, 1897, balance unexpended	$2,318.52
June 30, 1898, amount expended during fiscal year	1,157.26
July 1, 1898, balance unexpended	1,161.26

(See Appendix X 5.)

6. St. Francis River, Arkansas.—In its original condition this stream was not navigable at any stage above Lesters Landing; between Lesters Landing and Marked Tree navigation was possible at high stages only, and below Marked Tree it was difficult at medium stages. Snags and fallen timber were the principal obstructions.

The original project was to improve navigation below Lesters Landing by cutting a channel through "The Lake" and clearing the river of obstructions by snagging operations. The present project (adopted October 21, 1884) is to remove drift, logs, and snags from the channel and overhanging timber from the banks from the mouth to Kennett, Mo., (279 miles), and close chutes and sloughs in "The Sunk Lands," so as to make the river navigable at high stages to Kennett, Mo., at medium stages to Marked Tree, and at low stages to a point about 30 miles below Madison, Ark.

The amount expended up to the close of the fiscal year ending June 30, 1897, was $55,782.11.

The condition of the improvement on June 30, 1897, was that the river below Marked Tree was in good condition when at 4-foot stage or over, and above Marked Tree a fair high-water channel had been made through "The Sunk Lands."

During the fiscal year ending June 30, 1898, only a small amount of snagging was done. This work was confined to the lower reaches of the river and did not materially improve the channel. Funds for thorough work were not available. The survey provided for in river and harbor act of June 3, 1896, was completed and report is printed in House Doc. No. 125, Fifty-fifth Congress, second session, and is reprinted in this report as Appendix X 9.

Commercial statistics, year ending May 31.

Year.	Value.	Tons.	Year.	Value.	Tons.
1894	$98,375	19,763	1897	$1,117,891	97,348
1895	321,439	38,107	1898	237,481	23,819
1896	401,457	67,740			

July 1, 1897, balance unexpended	$3,217.89
June 30, 1898, amount expended during fiscal year	2,544.00
July 1, 1898, balance unexpended	673.89
July 1, 1898, outstanding liabilities	45.00
July 1, 1898, balance available	628.89
Amount (estimated) required for work annually	8,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	8,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix X 6.)

7. *St. Francis River, Missouri.*—In its original condition this river was almost entirely choked with snags, logs, and overhanging timber, and commerce was restricted to flatboating and rafting at high water.

The original project was for snagging operations and the removal of gravel shoals 12 miles below Greenville, Mo. Only snagging operations have been carried on.

The amount expended up to the close of the fiscal year ending June 30, 1897, was $20,440.03.

The condition of the improvement on June 30, 1897, was such as to allow small steamboats, towing barges drawing 2 feet, to navigate the river when at 3 feet above low water.

No work was done during the fiscal year ending June 30, 1898, and the stream is reported as rapidly filling with sunken saw logs and fallen timber. It will be necessary to remove periodically this class of obstructions, if the improvement is to be retained.

A proposed project and estimate for continuing improvement of this stream is printed on page 2000, Annual Report of the Chief of Engineers for 1897.

Commercial statistics, year ending May 31.

Year.	Value.	Tons.	Year.	Value.	Tons.
1894	$145,118	35,806	1897	$75,425	23,306
1895	79,091	22,326	1898	72,873	23,170
1896	135,029	35,497			

July 1, 1897, balance unexpended	*$59.97
July 1, 1898, balance unexpended	59.97
July 1, 1898, outstanding liabilities (estimated)	59.97

(See Appendix X 7.)

SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The surveys of the following localities, required by the river and harbor act of June 3, 1896, were made by the local engineer, Capt. W. L. Sibert, Corps of Engineers, and reports thereon submitted:

1. *Survey of Arkansas River at Dardanelle, Ark.*—Captain Sibert submitted report, dated October 26, 1897, of survey to determine whether or not, by reason of dikes or other Government works, any part of the harbors or river banks in their vicinity have been so injured or endangered that the Government should guard against or remedy the same. He is of opinion that the dikes constructed by the United States above the town of Dardanelle have not so injured or endangered the harbor or river banks in their vicinity that the Government should guard against and remedy the same, and he therefore recommends that the bank in question should not be protected by the United States. His views are concurred in by the division engineer, Col. Henry M. Robert, Corps of Engineers. The report was transmitted to Congress and printed in House Doc. No. 106, Fifty-fifth Congress, second session. (See also Appendix X 8.)

2. *Survey of St. Francis River, Arkansas, with a view to affording slack-water navigation up to Wittsburg and to Marianna on L'Anguille River.*—Captain Sibert submitted report of survey November 6, 1897.

* Balance shown in Annual Report for 1897 was in error 56 cents.

He presents a plan for improvement by construction of an 18-foot lift lock and fixed dam at Rock Bar on the St. Francis to secure slack water at Marianna, and an additional lock and dam with 15-foot lift to continue slack water to Wittsburg, the estimated cost, including dredging at the mouth and contingencies, being $659,770, but he states that, in view of the character of material composing the banks and bottom of the lower St. Francis, it would be an extremely doubtful experiment to try to maintain a fixed dam with a lift of 18 feet at Rock Bar, and that, in his opinion, it is impracticable to make slack-water navigation to Marianna on L'Anguille River.

A second plan, eliminating that part of the project providing for slack water to Marianna, is proposed by Captain Sibert with a view to obtaining 3-foot navigation to Wittsburg at low water by construction of three locks with movable dams, the estimated cost of which, including dredging at the mouth and contingencies, is placed at $980,720.

Captain Sibert further states that—

> A large portion of the St. Francis Valley is liable to overflow by the Mississippi River, which fact retards its development. On account of this and the cost of the proposed work in comparison with the commerce likely to be developed, I am of the opinion that the river is not worthy of improvement by locks and dams at the present time.

The report was transmitted to Congress and printed in House Doc. No. 125, Fifty-fifth Congress, second session. (See also Appendix X 9.)

REMOVING SNAGS AND WRECKS FROM MISSISSIPPI RIVER; IMPROVEMENT OF MISSISSIPPI RIVER BETWEEN THE OHIO AND MISSOURI RIVERS, OF HARBOR AT ST. LOUIS, MO., AND TO PREVENT THE MISSISSIPPI FROM BREAKING THROUGH INTO CACHE RIVER AT BEECHRIDGE, ABOVE CAIRO, ILL.

This district was in the charge of Maj. Thos. H. Handbury, Corps of Engineers, having under his immediate orders Lieut. Charles S. Bromwell, Corps of Engineers, from September 16, 1897, to April 11, 1898. Division Engineer, Col. Henry M. Robert, Corps of Engineers.

1. Removing snags and wrecks from the Mississippi River below the mouth of the Missouri River.—Before this work was inaugurated, and for many years afterwards, the navigation of the river was very much interfered with by numerous snags, logs, etc., which had lodged in the channel and to which new additions were made with each rise in the river. A large number of wrecked flatboats, barges, steamboats, and all manner of river craft are found in the navigable channels, and menace life and property.

For the removal of these obstructions appropriations were made as early as 1824. The project adopted consisted of building boats suitable for removing the snags, logs, rack heaps, etc., and operating them whenever the stage of water was favorable and funds were available.

The amount expended upon this work on the reach of the river below the mouth of the Missouri prior to 1879 can not now be definitely ascertained for the reason that during much of the time appropriations were made at irregular intervals in lump sums to be applied to several streams as their needs or the terms of the law might require. From March 3, 1879, when the first specific appropriation was made, up to June 30, 1897, there has been expended $1,282,928.36. This expenditure made great improvement in the navigation of the river and lessened the danger to boats. During the fiscal year ending June 30, 1898, the sum of $88,917.74 has been expended.

Two steel snag boats were employed in removing the obstructions to navigation between the mouth of the Missouri River and New Orleans.

The work resulted in removing 4,253 snags, 32 drift piles, 2 steamboats, and 1 barge wreck, and cutting down 14,856 trees.

The bottom of the snag boat *J. N. Macomb*, after continuous service since 1874, had become so pitted and corrugated with rust that it could no longer be operated with safety. Proposals were solicited by advertisement in February last for renewing this. But one bid was received and that was unsatisfactory in several respects. Authority was given to the officer in charge to do the work by hired labor. At the end of the fiscal year the work was nearly finished. It is expected that the boat will be ready for service at the commencement of the next low-water season.

An annual appropriation, not to exceed $100,000, for carrying on this work was made by the act of August 11, 1888. Under this appropriation the two snag boats will patrol the river and remove obstructions where necessary.

Amount drawn under section 7, act of August 11, 1888	$88,917.74
June 30, 1898, amount expended during fiscal year	88,915.27
July 1, 1898, balance unexpended	2.47
July 1, 1898, outstanding liabilities	2.47
July 1, 1898, amount available for fiscal year ending June 30, 1899	100,000.00

(See Appendix Y 1.)

2. *Mississippi River, between Ohio and Missouri rivers.*—The original condition of the navigable channel of this portion of the Mississippi River before the work of improvement was begun was such that the natural depth at low water was in many places from 3½ to 4 feet. The channels were divided by islands, which formed sloughs and secondary channels, through which a great deal of the volume of the flow was diverted, to the detriment of navigation.

The first work for improvement began in 1872, and was continued for a number of years as appropriations were made, the works consisting of dikes and dams of brush and stone, erected with a view to confining the low-water volume to a single channel, and of revetments to hold and preserve the banks where necessary or advisable to do so.

The present project is a continuation of the plan adopted in 1881. It also contemplates confining the volume of the river at low water to a single channel, its approximate width to be, below St. Louis, about 2,500 feet, the natural width being in many cases from 1 to 1½ miles. The method principally employed is the closing of sloughs and secondary channels and building up of new banks out to the line desired, using the solid matter brought down by the river and which is collected by means of hurdleworks. The banks, both new and old, are revetted where necessary.

The object of the improvement is to obtain eventually a minimum depth, at standard low water, of 6 feet from the mouth of the Missouri to St. Louis, and of 8 feet from St. Louis to the mouth of the Ohio.

The original estimate of the cost of the improvement, as revised in 1883, is $16,397,500.

The total amount expended to June 30, 1897, was $7,070,814.39, exclusive of $180,000 allotted by acts to projects for improvement between the Illinois and the Missouri rivers, including Alton Harbor.

The amount expended during the fiscal year ending June 30, 1898, is $868,793.96. This includes $288,585.47 expended during the year for dredge plant, portable jetties, and for operating the same. The total

amount thus far expended for what is termed temporary channel improvements is $437,769.90, the most of which has been for plant that is now on hand and available for future work. The approximate value of this plant is $343,000.

The result of the expenditure of this amount has been the partial improvement of the whole reach of the river from St. Louis to Cairo. During last year there was at all times throughout this reach a navigable channel 5 feet or more in depth, notwithstanding that the river reached a low-water stage of 1.2 feet below the standard low water.

The work done during the last year in the line of permanent improvement consisted in repairs to existing contraction works and revetment, and a further extension of the same in localities where work had been commenced.

New work was commenced above the head of Arsenal Island, to preserve the head of the island and to force the channel nearer the Missouri shore; at the lower end of the Ste. Genevieve Bend, to hold the bank in that locality and limit the oscillations of the river; at Hamburg Chute, to prevent about one-half the low-water discharge of the river going through it, and by concentrating the water on the west side of the island increase the depth in the navigable channel; at the head of Devils Island, to prevent erosion of the bank and hold the river in proper alignment; at the lower end of the island near Minton Point, to contract the width of river bed and improve a shoal crossing at that point; near Commerce, to correct excessive width in the river and improve shoal crossings; and behind Bird Island near Buffalo Island, to shut off the flow of one-half the river and concentrate it over a shoal crossing. At all places where work was done before the last low-water season the effect was manifest in an improved condition of navigation.

Repairs and additions were made to works already in existence at Twin Hollows, Illinois; Chesley Island, Missouri; Michaels Landing, Missouri; Sycamore Landing, Illinois; Moro Island, Illinois; opposite Chester, Ill.; Anchor Landing, Missouri; Wagners Landing (Liberty Bend), Illinois; and Doolans Slough.

Opposite to Chester, Ill., the balance of the allotment of $30,000, made by river and harbor act of June 3, 1896, was expended in raising the revetment to the height of 20 feet above low water.

The $22,500 allotted by the river and harbor act of August 5, 1886, for continuing improvement at Cape Girardeau, Missouri, and Montana (Minton) Point, Illinois, from the general appropriation of that year for work in this reach of the river, was expended during the year in building contraction hurdles in the vicinity of Minton Point and improving a shoal crossing just above Cape Girardeau.

Work for the temporary improvement of the channel by means of portable jetties and dredging appliances was done at the following localities: Riverside, Harrisonville, Platin Rock, Grand Tower Bend, 76 Landing, Juden Creek, and Buffalo Island.

The jetties varied in length from 450 feet to 2,230 feet. The total length built and removed during the season was 9,345 feet, at an average cost of $3 per foot, including all expenses.

By means of these temporary expedients a gain in depth of channel varying from 6 inches to 3 feet was effected.

The two steel-hulled hydraulic dredges mentioned in last annual report as being under contract and to be completed about the middle of last October were not finished in time for last season's low-water work. They were delivered, one January 31, 1898, the other April 15,

1898. The tests made show that they are fully up to the required capacity of 1,000 yards each. They will be available for work during next low-water season.

With these appliances to aid the work put in place for the permanent improvement of the channel, it is confidently expected that at least 6 feet depth will be maintained during future low-water seasons between St. Louis and Cairo.

The funds now available will be expended in carrying out the original project and in the temporary work required by the river and harbor act of June 3, 1896.

The sum asked for the fiscal year ending June 30, 1900, will be applied to a continuance of the same work.

To prevent the suspension of this important work for lack of funds, the river and harbor act of June 3, 1896, makes provision for three years' work from July 1, 1897, to be paid for as appropriations are made by law, at the rate of $673,333.33 annually.

July 1, 1897, balance unexpended		$782,518.93
Amount appropriated by deficiency act approved July 19, 1897		325,000.00
Amount appropriated by sundry civil act approved July 1, 1898		673,333.33
		1,780,852.26
June 30, 1898, amount expended during fiscal year		868,793.96
July 1, 1898, balance unexpended		912,058.30
July 1, 1898, outstanding liabilities	$3,223.64	
July 1, 1898, amount covered by uncompleted contracts	56,234.98	
		59,458.62
July 1, 1898, balance available		*852,599.68

Amount (estimated) required for completion of existing project	8,219,166.68
Amount that can be profitably expended in fiscal year ending June 30, 1900	673,333.33
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix Y 2.)

3. Harbor at St. Louis, Mo.—St. Louis Harbor is about 18 miles long and divided into two nearly equal parts by the Eads Bridge. The upper part, included between the bridge and the northern limits of the city, is about 10 miles in length.

Three miles above the Eads Bridge is the Merchants Bridge. The lower part of the harbor, included between Eads Bridge and the River Des Peres, is 8 miles long. The channel in this part of the harbor has sufficient depth and accessible landings at all points. Good depth exists above the Merchants Bridge.

Congress, by act approved September 19, 1890, appropriated $182,000 for improvement of this harbor.

The navigable reach between the Eads Bridge and Merchants Bridge was at that time obstructed by a number of middle bars. The project adopted for improvement of the harbor under the appropriation of 1890 consisted in a contraction of the waterway between those bridges to a width of about 2,000 feet, in order to concentrate the flow upon the bars, and thus cause scour to the depth desired. The contraction

* Of this balance special allotments have been made by Congress, as follows:

Bank protection at Cairo, Ill., act of July 5, 1884 (balance)	$8,600
Bank protection on east side of Mississippi River opposite mouth of Missouri River, act of June 3, 1896	50,000
Total	58,600

works consisted of a series of hurdles extending out from the Illinois shore, the object of the hurdles being to collect deposits of material brought down during floods, and thus build up a new bank out to the line desired.

This work, which was accomplished by the close of the fiscal year ending June 30, 1892, caused extensive deposits of sediment along the line of hurdles, and has resulted in considerable increase in channel depth, with corresponding benefit to navigation.

Amount expended to July 1, 1897, $150,762.03. There was no expenditure during the past fiscal year.

The full amount of the estimate for the improvement of this part of the harbor has been appropriated. With the balance remaining it is proposed to repair damage that may occur to the hurdles from ice and drift and to extend them wherever found necessary to do so.

July 1, 1897, balance unexpended	$31,237.97
July 1, 1898, balance unexpended	31,237.97

(See Appendix Y 3.)

4. To prevemt the Mississippi River from breaking through into the Cache River at or near a point known as Beechridge, a few miles above Cairo, Ill.—The sundry civil act approved June 4, 1897, contains an item providing for this work which reads as follows:—

For the purpose of preventing the Mississippi River from breaking through into the Cache River at or near a point known as Beach Ridge [Beechridge], a few miles north of Cairo, whereby the National Cemetery at Mound City, at the mouth of the Cache River, and the marine hospital at Cairo would be in imminent danger of destruction, the sum of one hundred thousand dollars, or so much thereof as may be necessary, is hereby appropriated, to be immediately available.

The project for this work not being based upon a survey under the Engineer Department and the extent of the work contemplated not being known, an estimate of its total cost can not be given. From a study of the conditions involved, it would seem that the object of the appropriation can best be carried out by revetting as great a length of the bank of the Mississippi River in the vicinity of Beechridge Railroad Station as the funds will suffice.

The project for the expenditure of the amount appropriated contemplates commencing at a suitable point on the bank of the river a short distance above the nearest point to Beechridge Station, building a short hurdle out into the stream to protect the head of the revetment, and then revetting the bank in the usual manner down as far as the funds will suffice.

Under this project a hurdle 275 feet in length was constructed, and 8,250 linear feet of low-water revetment was put in place, 3,375 linear feet of the bank being revetted to a 30-foot stage, and 4,875 feet to stages varying from 30 to 10 feet. The low-water revetment was about 130 feet in width, extending from the low-water line out into the river. Four hundred and forty feet of the upper portion of this was made of brush and the remainder of lumber about 1 inch thick, from 4 to 6 inches wide and 12 feet in length. This was woven in and out similar in manner to using the brush. It makes an excellent mattress when used in this way.

After the high water had graded the bank back, the upper revetment of stone was put on.

The work is being done by purchase of material in open market and hired labor, using Government plant belonging to the general improvement of the river between the mouth of the Missouri River and the mouth of the Ohio River.

A survey was made of Greenleaf Bend in the Mississippi River, and Cache River from this vicinity to its mouth on the Ohio River near Mound City, Ill.

The funds available will be sufficient to complete, including work already done, about 10,000 feet of revetment to a height about the 30-foot stage.

July 1, 1897, balance unexpended	$100,000.00
June 30, 1898, amount expended during fiscal year	33,427.70
July 1, 1898, balance unexpended	66,572.30
July 1, 1898, outstanding liabilities	3,385.75
July 1, 1898, balance available	63,186.55

(See Appendix Y 4.)

IMPROVEMENT OF MISSISSIPPI RIVER, BETWEEN MOUTH OF MISSOURI RIVER AND ST. PAUL, MINN., AND OF GALENA RIVER, ILLINOIS.

This district was in the temporary charge of Lieut. Charles Keller, Corps of Engineers, to September 25, 1897; in the charge of Lieut. Col. W. R. King, Corps of Engineers, from September 25, 1897, to May 18, 1898, with Lieutenant Keller under his immediate orders to April 9, 1898, and in the charge of Capt. C. McD. Townsend, Corps of Engineers, since May 25, 1898. Division Engineer, Col. J. W. Barlow, Corps of Engineers, since May 25, 1898.

1. Operating snag boats and dredge boats on Upper Mississippi River.—By the river and harbor act of August 11, 1888, provision was made for operating snag boats and dredge boats on the Upper Mississippi River under a permanent appropriation, the sum so expended not to exceed $25,000 annually.

From July 1 to November 12, 1897, and from April 24 to June 30, 1898, the snag boat *General Barnard* was employed removing snags and other similar obstructions, and otherwise assisting interests of navigation between Minneapolis and the mouth of Missouri River. Dredge *Phœnix* and drill boat *No. 6* were engaged for a time in removing rock from the channel.

The total amount expended for snag-boat service to June 30, 1897, is $749,640.

The total amount of freight transported on the Upper Mississippi River during the calendar year 1897 was about 3,200,000 tons.

The amount expended during the fiscal year ending June 30, 1898, was $25,000.

(See Appendix Z 1.)

2. Mississippi River between Missouri River and St. Paul, Minn.—Under this head is carried on the improvement of through navigation. Systematic work began in 1878, and such good results have been secured as to demonstrate that with a continuance of operations under liberal appropriations the low-water channel of the Mississippi River between St. Paul and the Missouri River can be made sufficiently deep, available, and permanent to satisfy the demands of commerce. The navigation interests are very large and important. The amount of freight carried during 1897, including logs and lumber, was, approximately, 3,200,000 tons.

The original condition of the channel between the Missouri River and St. Paul was such that in low stages the larger boats were unable to proceed farther up the river than La Crosse or Winona, and in many seasons at points much lower down their progress was checked or seri-

ously hindered. In all such cases through freight was reshipped on small and light-draft boats or barges.

The originally adopted project for the improvement, which has not been materially changed, proposed the contraction of the channel or waterway by means of wing and closing dams to such an extent as, by means of the scour thereby caused, to afford a channel of sufficient width and of a depth of 4.5 feet at low water, to be eventually increased to 6 feet by further contraction.

There was expended on the improvement to June 30, 1897, the sum of $7,255,918.18. At that date, and for several years previous, the condition of the channel was such as to permit the passage of the largest river boats at very low stages through to St. Paul.

During the past year work has been carried on by hired labor and use of Government plant between St. Paul and Lake Pepin, at Kings Coulee in Lake Pepin, between Queens Bluff and Prairie du Chien, at Rock Island Rapids and Harbor, between Keithsburg and Nashville, at Burlington Harbor, between Keokuk and Quincy, at Warsaw-Quincy Levee, between Quincy and Hamburg, at Sny Island Levee, and between the Illinois and Missouri rivers; under formal contract, between Reeds Landing and Trempealeau, at Dubuque and Muscatine harbors, between Dubuque and Le Claire, between Rock Island and Keithsburg, between Keithsburg and Nashville, between Hamburg and Illinois River, and at the Flint Creek Levee; under agreement, at the Flint Creek and Warsaw-Quincy Levee.

There was expended for channel improvement during the year about $666,000, and an increased depth was obtained at many localities—never less than 1 foot and generally more.

As regards the Flint Creek to Iowa River Levee, two years ago the original estimate, $305,000, was for various reasons reduced to $250,000, which amount has already been appropriated. But it now appears that the levee section is not large enough and that the crest is too low, and authority has been given to readopt the original estimate, so that an additional $55,000 is needed to complete the work.

For La Crosse Harbor the estimate is $17,000, of which $5,000 is appropriated. The balance of $12,000 is needed to complete the improvement.

To prevent the suspension of this important work from lack of funds, the river and harbor act of June 3, 1896, makes provision for three years' work from July, 1897, to be paid for as appropriations are made by law, at the rate of $826,666.67 annually.

July 1, 1897, balance unexpended		*$947,374.86
Amount appropriated by deficiency act approved July 19, 1897		200,000.00
Amount appropriated by sundry civil act approved July 1, 1898		826,666.67
		1,974,041.53
June 30, 1898, amount expended during fiscal year		818,715.40
July 1, 1898, balance unexpended		1,155,326.13
July 1, 1898, outstanding liabilities	$16,338.03	
July 1, 1898, amount covered by uncompleted contracts	159,050.57	
		175,388.60
July 1, 1898, balance available		979,937.53
Amount that can be profitably expended in fiscal year ending June 30, 1900. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		826,666.67

(See Appendix Z 2.)

*The balance unexpended July 1, 1897, is $33,756.04 less than given last year, said amount having been transferred to appropriation for Lock and Dam No. 2.

3. Operating and care of Des Moines Rapids Canal and Dry Dock.—During the past fiscal year the Des Moines Rapids Canal was open for navigation 253 days, during which time there passed through it 792 steamboats and 395 barges, carrying 22,984 passengers, 18,314 tons of merchandise, and 78,157 bushels of grain. There also passed through the canal 68,300,704 feet B. M. of lumber, 22,128,000 feet of logs, 22,697,900 shingles, and 27,100,150 laths.

The dry dock was in constant use during the whole year.

The cost of operating and care of the canal is provided for by an indefinite appropriation made by act of March 3, 1881, and July 5, 1884.

The amount expended during the year was $38,504.95, including outstanding liabilities.

(See Appendix Z 3.)

4. Operating and care of Galena River improvement, Illinois.—This improvement, consisting of a lock and dam in the Galena River, was purchased by the United States in March, 1894, under provisions of act of Congress of September 19, 1890, at a cost of $100,000. During the past fiscal year the lock was open for navigation 202 days, during which time there passed through it 395 boats and barges, carrying 2,523 passengers and 2,237 tons of merchandise.

The cost of operating and care of the improvement is provided for under indefinite appropriation made by act of Congress approved July 5, 1884.

The amount expended during the year was $5,890.05, including outstanding liabilities.

(See Appendix Z 4.)

CONSTRUCTION OF RESERVOIRS AT HEAD WATERS OF MISSISSIPPI RIVER; IMPROVEMENT OF MISSISSIPPI RIVER FROM ST. PAUL TO MINNEAPOLIS, OF RIVERS IN WISCONSIN AND MINNESOTA TRIBUTARY TO MISSISSIPPI RIVER, AND OF RED RIVER OF THE NORTH, MINNESOTA AND NORTH DAKOTA; GAUGING MISSISSIPPI RIVER AT ST. PAUL, MINN.

This district was in the charge of Lieut. Col. W. A. Jones, Corps of Engineers, to September 24, 1897, and of Maj. Frederic V. Abbot, Corps of Engineers, since that date; Division Engineer, Col. J. W. Barlow, Corps of Engineers, since September 30, 1897.

1. Mississippi River between St. Paul and Minneapolis, Minn.: Construction of Lock and Dam No. 2.—[This work was in the charge of Lieut. Col. W. R. King, Corps of Engineers, to October 16, 1897.] By river and harbor act of August 18, 1894, authority was given for commencement of improvement of the river between St. Paul and Minneapolis by slack-water navigation. The original condition of the channel was such that at low stages it was navigable by very small boats only, and at all stages the current was so swift for about 3 miles that boats were unable to make headway against it. These conditions still prevail.

The original project, as yet unchanged, was the construction of Lock and Dam No. 2, near Meekers Island, to carry slack water from that point to Washington Avenue Bridge at Minneapolis. The estimated cost was $598,235. The amount expended on this project to the close of the fiscal year ending June 30, 1897, was $16,121.63.

During the year preparations have been made for the commencement of construction of the lock and dam. The necessary land has been secured. A detailed plan, with drawings, has been prepared. Other work of preparation has consisted in the procurement of traveling cableway and its partial erection, purchase of air-compressor plant,

stone crusher, the necessary engines and boilers for the operation of the plant, sinking an artesian well, the erection of the necessary buildings for carpenter and blacksmith shop, and engine and boiler houses.

July 1, 1897, balance unexpended	$184,756.04
June 30, 1898, amount expended during fiscal year	19,709.09
July 1, 1898, balance unexpended	165,046.95
July 1, 1898, outstanding liabilities	25,869.66
July 1, 1898, balance available	139,177.29

Amount (estimated) required for completion of existing project	397,357.33
Amount that can be profitably expended in fiscal year ending June 30, 1900	397,357.33

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix A A 1.)

2. Construction of reservoirs at head waters of Mississippi River.—The object of these reservoirs is to collect surplus water, principally from precipitation of winter, spring, and early summer, to be systematically released so as to benefit navigation on the Mississippi River below the reservoir dams.

Improvement of navigation of the Mississippi by means of reservoirs was the subject of a number of reports, preliminary and otherwise, from 1870 to 1881, both years inclusive. The estimate of cost of the proposed dams at the head waters of the Mississippi River in Minnesota was $573,660.08, the materials for construction to be mainly the timber and earth found in the country.

Later rearrangement of dams and revision of estimates brought the estimated cost of the reservoirs to about $675,000, not including land damages.

These dams are as follows: At Lake Winnibigoshish, Leech Lake, Pokegama Falls, Sandy Lake, Pine River, and Gull Lake. All of them have been completed excepting that for Gull Lake.

Authority for the construction of the Gull Lake Reservoir was originally given by Congress on condition that the United States should be at no expense for lands, mills, or property necessarily taken or injured. The act of June 4, 1897, removed a portion of the restriction by authorizing the use of a sum not exceeding $15,000 for payment of damages for lands or tenements overflowed. It is found that if the dam be built, the damages will be far in excess of the limit fixed, and it is believed that the construction should be abandoned, as the lands to be submerged have become too costly in comparison with the benefits the reservoir might secure to justify construction.

The total amount expended to the close of the fiscal year ending June 30, 1897, was $833,453.61. These expenditures cover cost of construction of five dams and their operating machinery, of superintendence and contingencies, of certain awards for damages, and of repairs; also of operating the dams up to February 1, 1895.

The expenditure has resulted in benefit during the low-water season to the navigable portions of the Mississippi River from Grand Rapids, Minn., to the confluence of the Mississippi and St. Croix rivers, about 22 miles below St. Paul.

The reasons given in the Annual Report of the Chief of Engineers for 1897, page 1681 et seq., for limiting the system to the reservoirs now actually constructed, have become more forcible as the country has been settled and lands have increased in value. The policy for the future should be to replace the present timber structures, which are annually

becoming more and more decayed, by permanent dams of concrete or masonry, to define by proper surveys the areas which the United States actually owns, and to acquire by purchase flowage rights over the large areas which, without any legal right, are now annually overflowed by the filling of the reservoirs, and the estimate presented contemplates such work. During the year equitable prices have been paid for flowage rights on a number of tracts of land lying below the dams, which are overflowed by a release of water.

The dams at Leech Lake and Lake Winnibigoshish have become so unsafe that the officer in charge reports that these reservoirs must be put out of use after the low-water season of 1898. To replace them with safe concrete dams will cost $100,000 each. To make it possible to fill Pine River Reservoir to its projected flowage line requires dikes costing $10,000.

The deficiency act approved July 7, 1898, authorizes the use of all unexpended balances of money heretofore appropriated for the construction of reservoirs, including the appropriation for constructing Gull Lake Reservoir, for the renewal and repair of the dams heretofore constructed.

There has been expended for reservoir dams, including repairs, etc., $841,381.31, of which $7,927.70 was expended in fiscal year ending June 30, 1898.

With regard to the question of titles to the Indian lands soon to be opened to settlers, a report has been submitted by the officer in charge and transmitted to the Secretary of the Interior. The only surveys from which the descriptions of the lands could be compiled were so incomplete that any descriptions taken from them before additional surveys are made are likely to be greatly in error.

For the commerce benefited by the reservoirs, reference should be made to the commercial statistics of the Upper Mississippi River.

July 1, 1897, balance unexpended	$72,046.39
June 30, 1898, amount expended during fiscal year	7,927.70
July 1, 1898, balance unexpended	64,118.69
July 1, 1898, outstanding liabilities	461.67
July 1, 1898, balance available	63,657.02
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	*270,000.00

(See Appendix A A 2.)

3. Operating and care of reservoirs at head waters of Mississippi River.—The river and harbor act of August 18, 1894, made applicable to the reservoirs at head waters of Mississippi River "so far as concerns their care, preservation, and maintenance," the provisions of the general appropriation for "operating and care of canals and other works of navigation, indefinite," contained in section 4 of the river and harbor act of July 5, 1884. The first allotment was made January 25, 1895, and the expenses from February 1, 1895, have been paid from the indefinite appropriation.

Ordinary repairs to Leech Lake, Winnibigoshish, Pokegama, and Pine River dams were made at an expense of $835.03. The road connecting Leech Lake and Winnibigoshish dams was repaired at a cost of $407.01.

* Required for renewal and repair of reservoir dams, as contemplated in the general deficiency act approved July 7, 1898.

The amount expended in care and maintenance of these reservoirs during the past year was $20,497.19.

For commercial statistics reference should be made to the reports on the Mississippi River.

(See Appendix A A 3.)

4. *Chippewa River, including yellow banks, Wisconsin.*—Before improvement the depth on the bars at low water seldom exceeded 18 inches, and the crossing at the mouth of the river was extremely difficult at that stage, as there were a number of channels of insufficient depth. Frequently the depth at the mouth was but 10 to 12 inches.

The first examinations and surveys of this stream were made in 1874 and 1875. Based upon the latter a project was prepared for the improvement, consisting of the revetment of caving banks and construction of dams and jetties from Eau Claire to the confluence of the stream with the Mississippi River, a distance of 56 miles, in order to confine the low-water volume to a channel of nearly uniform width; also to protect the five yellow banks bordering on the river and relieve the channel of the Chippewa River and of the Mississippi River below the junction of the two streams from the sand contributed by them. The first estimate of cost was $139,892.50. The project has remained unaltered, except an increase in the amount of work to be done. The estimate has been revised three times. The last one (made in 1888) placed the cost at $272,487.72.

For a full description of the river and detailed statement of the revision of project, reference is made to page 2183, Annual Report of the Chief of Engineers for 1895.

Total expended from commencement of operations in 1877 to June 30, 1897, $183,859.57.

The improvement to June 30, 1897, has provided a permanent channel 3 feet deep over the bar at the mouth of the river, and has materially increased the depths over the Durand, Plum Island, Plum Island Flats, Battle Island, Wacouta Island, and Flower Pot Island bars, besides straightening a difficult piece of river at the Madison Street Bridge, in Eau Claire, and stopping a difficult and dangerous cut-off at Dead Lake. Where the improvements have been completed, the channels are 3 feet or more in depth. The improvement has effected a material reduction in the cost of running rafted lumber from Eau Claire to the mouth of the river.

No work of consequence has been done at the yellow banks since 1883, at which date about one-fifth of the banks had been revetted.

The work of the past year being only repairs, has produced no effect in the way of increased depths.

The river traffic at present is confined to the rafting of manufactured lumber and the running of loose logs. The annual tonnage of rafted lumber is about 300,000 tons, and of loose logs about 1,000,000 tons.

July 1, 1897, balance unexpended	$7,890.43
June 30, 1898, amount expended during fiscal year	4,030.95
July 1, 1898, balance unexpended	3,859.48
July 1, 1898, outstanding liabilities	792.44
July 1, 1898, balance available	3,067.04
Amount (estimated) required for completion of existing project	80,737.72
Amount that can be profitably expended in fiscal year ending June 30, 1900	40,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix A A 4.)

5. *St. Croix River, Wisconsin and Minnesota.*—Before the improvement was begun the low-water depth in the channel above Lake St. Croix was but 2 feet on many of the bars. In Lake St. Croix, and below, the channel over Hudson and Catfish bars was narrow and tortuous.

The project for improvement contemplates removal of snags, bowlders, bars, etc., and the contraction of the low-water channel from Taylors Falls to the head of Lake St. Croix; widening and straightening the channel where it is narrow or tortuous in Lake St. Croix by dredging and contraction works; also the improvement of the harbor and water front of Stillwater, Minn.

The object of the improvement is to furnish an open channel, 3 feet deep, from Taylors Falls to the confluence with the Mississippi River, 52.3 miles, and better harbor facilities at Stillwater. The estimated cost is $136,700. The river and harbor act of June 3, 1896, allotted, from the general appropriation for the river, the sum of $10,000, to be used in improving Stillwater Harbor, the upper part of Lake St. Croix.

The total expenditures to June 30, 1897, were $114,687.19.

By June 30, 1897, the projected work between Stillwater and the mouth had been accomplished, but above Stillwater little effect had been produced. At a few points trouble is experienced, and some wing dams should be put in at these places; but generally the money should be applied to the lower river, which is much used by the steamers towing log rafts to the Mississippi River.

During the past year the only work has been repairs to some of the dams and the construction of a small dredge to be used near Stillwater. No increased depths have been secured during the year, as the dredge was only completed late in June, 1898.

The commerce of the river at present consists of tows of lumber and log rafts. The total tonnage passing over the river is approximately 2,000,000 tons per annum.

July 1, 1897, balance unexpended	$12,812.81
June 30, 1898, amount expended during fiscal year	7,467.89
July 1, 1898, balance unexpended	5,344.92
July 1, 1898, outstanding liabilities	1,293.68
July 1, 1898, balance available	4,051.24
Amount (estimated) required for completion of existing project	9,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	9,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix A A 5.)

6. *Minnesota River, Minnesota.*—There has been no navigation on this river during the past year so far as known, and petitions are on file in this office calling for the removal of the works of improvement heretofore put in at the mouth of the river. The small balance unexpended has been turned into the Treasury, and no further report will be submitted on this work, unless Congress provides money to renew the effort to improve this river.

Up to June 30, 1897, $131,370.45 had been expended.

July 1, 1897, balance unexpended	$129.55
June 30, 1898, amount expended during fiscal year	127.20
Returned to the Treasury of the United States	2.35

(See Appendix A A 6.)

7. *Red River of the North, Minnesota and North Dakota.*—When the improvement of this river began, the navigation of the reach from Breck-

enridge to Moorhead, 97 miles, was difficult at all stages and impossible at low water. The second reach from Moorhead to Grand Forks, 155 miles, had a ruling depth at low water of 1.5 feet. The third reach from Grand Forks to the boundary line of the United States, 143.5 miles, had a ruling low-water depth of 2 feet. The low-water navigation of Red Lake River was obstructed by bowlders between Thief River Falls and High Landing, a distance of 35 miles, and by a bad bar at its connection with Red Lake.

The present project is the same as the original (adopted December, 1877), except that an open-channel improvement was substituted in 1886, by act of Congress, for the proposed lock and dam at Goose Rapids, and the improvement of Red Lake River between Thief River Falls and Red Lake was added by the terms of the river and harbor act of Congress of June 3, 1896.

The object of the improvement is to provide an open channel on the Red River of the North from Breckenridge to the northern boundary line, 395.5 miles, as follows:

1. Breckenridge to Moorhead, 97 miles; a channel capable of being navigated during high and medium stages of water.

2. Moorhead to Grand Forks, 155 miles; a channel 50 feet wide and 3 feet deep at low water.

3. Grand Forks to the northern boundary line, 143.5 miles; a channel 60 feet wide and 4 feet deep at low water.

Also to provide a 3-foot open channel improvement of the Red Lake River and Red Lake from Thief River Falls to and including Red Lake, a total distance of 135 miles.

The original estimated cost was $364,598.17; increased in 1883 to $398,598.17. The estimate was revised in 1887, after Congress had substituted an open-channel improvement for lock and dam at Goose Rapids, and placed at $252,598.37. An increase of the latter was authorized May 8, 1893, to $310,320. Congress, in 1896, added $5,000 to the estimate of cost by attaching the improvement of Red Lake River to the project, making the present estimate of cost from the commencement of work $315,320. This does not cover cost of the project for Red Lake River.

The total amount expended to June 30, 1897, was $267,651.22.

By June 30, 1897, the object had not been obtained on the first division of the Red River of the North, which has for some years been closed against all navigation by permanent pile bridges. The Secretary of War has approved leaving these bridges as they stand, as there was no navigation affected thereby. The object was obtained on the third division and on all but 13 miles of the second, but annual dredging will be needed to maintain the depth. On Red Lake River 104 cubic yards of bowlders had been removed.

During the past year but little dredging has been possible, on account of the badly rotted state of the dredge hull and the depreciated condition of the rest of the plant. About a mile of training dam has been built. On Red Lake River 35 miles was worked over, much improving the navigation of the stream at low water.

On the Red River of the North the expenditures for the past fiscal year have been $6,174.01.

On Red Lake River the expenditures for the last fiscal year have been $2,351.79.

Navigation on Red River is confined to comparatively short reaches north and south of Grand Forks, and consists mainly in the transportation of wheat to Grand Forks by two steamboats (100 and 12 tons

respectively) and 6 barges. The tonnage during the year 1897 was 13,840, a falling off from that of 1896 of about 5,000 tons.

On Red Lake River three steamers of 50 tons each were operated, carrying general merchandise and passengers; the total tonnage in 1897 being 642, and 901 passengers. Twenty-two million feet b. m. of logs was run on the river during the year. Two large steamboats are run on Red Lake towing logs, the quantity moved being about 21,000,000 b. m. feet.

July 1, 1897, balance unexpended	$10,348.78
Refund of overpayment	5.00
	10,353.78
June 30, 1898, amount expended during fiscal year	8,530.80
July 1, 1898, balance unexpended	1,822.98
July 1, 1898, outstanding liabilities	186.58
July 1, 1898, balance available	1,636.40
Amount (estimated) required for completion of existing project	37,320.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix A A 7.)

8. *Gauging Mississippi River at or near St. Paul, Minn.*—The river and harbor act of August 11, 1888, authorized the gaugings, but none were made until the fall of 1889. Since the latter date gaugings have been made as frequently as the funds available would permit.

Owing to the condition of the reservoirs they will not be in use during the season; the observations are not therefore necessary.

Amount expended to June 30, 1897, $4,900.

The records indicate that a rise in the river at St. Paul commences in seven or eight days following the release of the water from the distributing reservoir at Pokegama Falls, and in about five days thereafter the full effect is felt. The mean time is, therefore, ten days.

For commercial statistics reference is made to the reports upon the Mississippi River.

Amount allotted for the fiscal year ending June 30, 1898	$500.00
June 30, 1898, amount expended during the fiscal year	500.00

(See Appendix A A 8.)

SURVEY MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The survey of *Big Stone Lake and Lake Traverse, Minnesota, with a view to the construction of reservoirs* required by the river and harbor act of June 3, 1896, was made under the direction of the local engineer, Lieut. Col. W. A. Jones, Corps of Engineers, and report thereon submitted November 15, 1897. The report is accompanied by a subreport of Mr. W. C. Weeks, who made the survey. Mr. Weeks submits certain plans for which the estimated cost is $745,965. Lieutenant-Colonel Jones modifies these plans and submits estimates of cost amounting to $350,000.

The plans and estimates presented must be considered preliminary, and should Congress decide to make provision for this work, much further detailed study of the proposed work must be made.

The report was transmitted to Congress and printed in House Doc. No. 134, Fifty-fifth Congress, second session. (See also Appendix A A 9.)

IMPROVEMENT OF MISSOURI RIVER AT AND ABOVE SIOUX CITY, IOWA, AND OF YELLOWSTONE RIVER, MONTANA AND NORTH DAKOTA.

This district was in the charge of Capt. J. C. Sanford, Corps of Engineers. Division Engineer, Col. J. W. Barlow, Corps of Engineers.

1. Missouri River between Stubbs Ferry, Montana, and the lower limits of Sioux City, Iowa.—The river distance between the above points is 1,660 miles. By its physical characteristics this portion of the river is divided into four sections: The first, Stubbs Ferry to Greatfalls, Mont., 130 miles, is the navigable portion above the "Great Falls;" the second, Greatfalls to Fort Benton, Mont., 49 miles, is an unnavigable section, occupied by cataracts and dangerous rapids; the third, Fort Benton to Carroll, Mont., 172 miles, known as the "Rocky River," contains numerous rapids and rock obstructions, but has carried a heavy commerce; the fourth, Carroll to Sioux City, 1,309 miles, known as the "Sandy River," is characterized by muddy water, sand bars, and a shifting channel, with easily eroded and constantly eroding banks. Navigation is difficult at low water, due to the too great width of the river in many places. The upper 158 miles forms a transition portion between the "Rocky" and "Sandy" rivers.

Between Stubbs Ferry and Greatfalls.—This reach consists of two distinct portions. From Stubbs Ferry to just below the town of Cascade, 76 miles, the average slope is 3.73 feet per mile. Numerous rapids and rock obstructions exist in this reach. A channel depth of less than 2.5 feet at low water is found at a number of places (said to be fifteen). Below this rapid portion the "Long Pool" extends to Greatfalls, 54 miles. The average slope is only 0.52 foot per mile. A channel depth of 3 feet originally existed throughout the greater part of the pool, though a less depth was found at a number of places.

In 1880 a small amount of rock removal work had been done at the worst two rapids above Cascade, under an appropriation for improving the Missouri River above the mouth of the Yellowstone River.

The original project, submitted January 23, 1892, contemplated obtaining a channel 3 feet deep at low water from Greatfalls to Cascade and a channel of 2.5 feet low-water depth from Cascade to the canyon next below Stubbs Ferry, at an estimated cost of $115,837.50. The only work contemplated between Greatfalls and Cascade was on the 4 miles next below Cascade.

This project was based on maps of survey made in the spring of 1880, on which, as appears from recent data, the stages shown were from 2 to 3 feet too low. A revised project, contemplating the same results, but providing for improvement of a number of shoals found in 1894 nearer Greatfalls, and for the removal of certain artificial obstructions, in addition to the work provided for in the original project, was adopted November 30, 1894. In this project the estimate for the whole work was increased to $165,812.50. An examination made in September, 1897, between Greatfalls and Cascade showed that at a number of places, the improvement of which was not contemplated in the project of November 30, 1894, a less depth than 3 feet then existed, and at others the depth reduced to low water would have been less than 3 feet, some of these latter being, however, as shown by later observations, only temporary obstructions. A further revision of the project, increasing the amount of work below Cascade and its estimated cost, was therefore necessitated. This revised project was adopted January 4, 1898. In it the estimate for the whole work is increased to $213,646.50, the same results being contemplated as in the two previous projects and the

same amount of work above Cascade being provided for. The project also contains an estimate, as did the previous projects, of $4,500 for annual maintenance.

To June 30, 1897, there had been expended on the project of November 30, 1894, $31,207.46, by which a channel of the proposed depth had been obtained from Greatfalls to Griffin Bar, about 12 miles. The shortness of the improved channel had prevented any marked effect on commerce.

During the fiscal year $16,486.58 has been expended, carrying the 3-foot channel to Buckshot Island, about 16 miles above Greatfalls, and beginning the improvement of Bird Creek Shoal, the present head of the 2½-foot channel, about 48 miles above Greatfalls.

The maximum draft that can now be carried at low water over the shoalest part of the locality under improvement is about 2 feet at Bird Creek Shoal.

Between Greatfalls and Fort Benton.—Original condition described above. No work has ever been projected for this difficult reach.

Between Fort Benton and Carroll.—The original low-water depth was less than 30 inches. The project contemplates the removal of bowlders, the contraction of the channel on shoals, and dredging. The total expenditures to June 30, 1896, were about $630,000, including cost of before-mentioned work above Greatfalls, resulting in removal of the principal obstructions and improvement of the worst shoals. No work has been done since 1891, navigation having ceased. The works have been damaged by ice and many of the dredged channels have filled up.

The maximum draft that can now be carried at mean low water between Fort Benton and Carroll is probably less than 30 inches; between Carroll and Sioux City, about 30 inches.

At Bismarck Harbor.—The high-water channel above and below Bismarck was of excessive width, being divided by several bars and islands. The channel shifted frequently, rendering erosion liable to occur at almost all points on either bank throughout the reach. A serious erosion of the right bank a short distance above the bridge was in progress, where the river threatened to break through into the Heart River.

Under a project for the expenditure of the allotment of $40,000 made by the river and harbor act of August 18, 1894, 7 pile dikes had been built in 1895 to check this erosion. The project formed part of a general plan, submitted at the same time, for the rectification of the river for about 5 miles above and 5 miles below Bismarck, at an estimated cost of $725,000. The dikes have been damaged by ice, drift, and high water in each spring since their construction. The damage done in the spring of 1896 was partially repaired in May of that year under transfer of $2,328.21 from balances of the appropriations of 1890 and 1892.

The present project, adopted September 29, 1896, provides for expending the $32,000 allotted from the appropriation of June 3, 1896, in thoroughly repairing the dikes constructed in 1895, and in constructing two dikes in continuation downstream of this group and in protecting the left bank just below the bridge, in accordance with the general plan.

To June 30, 1897, there had been expended in this locality $59,048.57. For the protection of the left bank below the bridge two short dikes have been nearly completed and the bank revetted for 500 feet below the warehouse at the steamboat landing. One of the proposed dikes in continuation of the group constructed in 1895 had been begun. The latter group had been severely damaged by ice in the spring of 1897, the lower one, No. 7, and a considerable part of No. 5 having been

destroyed, excepting the foot mattress, as well as the outer portions of the other dikes. It had been decided to restore Nos. 7 and 5 and to hold the others at the lengths then existing by building strong T heads and repairing the damaged bracing and screening, and these repairs have been over one-half completed.

The expenditures during the fiscal year have been $10,526.25. The two short left-bank dikes below the bridge and the right-bank dike below the 1895 group have been completed, as well as the repairs to that group. Lesser further repairs to Nos. 5 and 7 and to the right-bank dike below, necessitated by damage in the spring of 1898, have been begun.

The works constructed and completed during the year have protected the left bank just below the bridge, and have given a more favorable direction to the channel above the bridge.

At Pierre and Fort Pierre.—The river here, for about 7 miles, extending from above Pierre to below Fort Pierre, was of excessive width, being divided by numerous islands and bars. The low-water channel was liable at times to occupy any place between the high-water banks, and the latter were liable in places to erosion. The steamboat landing at Pierre had silted up, erosion had occurred on the Pierre front below it, and the Fort Pierre front was cutting badly. The crossing between Pierre and Fort Pierre was very shoal and changeable in position.

Under a project for the expenditure of the allotment of $40,000 made by the river and harbor act of August 18, 1894, 5 dikes were, in 1895, built in front of Fort Pierre. One dike in front of Pierre was completed and a second dike partly completed, and a dam built closing the chute behind Marion Island. The project formed part of a general plan, submitted at the same time for the rectification of the above 7 miles of river in this locality, at an estimated cost of $360,000. Under a project adopted July 24, 1896, for the expenditure of the allotment made by the river and harbor act of June 3, 1896, in work under the general plan, a revetment below Bad River (Fort Pierre) and a dike on the Pierre side had been begun. Work on the dike was stopped after it had been carried out far enough to cut off a chute that had caused dangerous erosion.

The present project is a modification of that of July 24, 1896, and provides for the expenditure of the allotment of $40,000 from the appropriation of June 3, 1896, in repairing the Marion Island Dam, which had settled in places during high water; in completing the dike at Pierre left unfinished in 1895; in revetting the right bank between Bad River and the bluff contact below, and in protecting the lower end of Marion Island so far as funds would permit; all in accordance with the general plan.

Expenditures at this locality to June 30, 1897, amounted to $63,385.43. The revetment below Bad River had been completed, the Marion Island Dam had been twice repaired, and the unfinished 1895 dike at Pierre nearly completed. The effect of the work had been to stop all erosion along and below the Fort Pierre front and some of that on the Pierre side.

The expenditures during the fiscal year have been $13,551.95. The incomplete 1895 dike at Pierre has been completed, and the lower end of Marion Island has been protected by two dikes and a revetment 1,220 feet long below them, the dikes extending out to the proposed rectification line. Minor repairs to the Marion Island dikes and revetment and to the dikes in front of Fort Pierre have been made during the present spring. The works have nearly stopped the erosion below the Pierre steamboat landing, having formed a large accretion, and

have protected that part of Marion Island covered by them. A marked improvement in the crossing between Pierre and Fort Pierre has also been effected.

At Yankton.—The river in the vicinity of Yankton is of excessive width, and its channel is constantly shifting. Due to changes in its position in the last few years, a wide bar has formed in front of the steamboat landing. No work of improvement had been done by the General Government in this vicinity prior to the act of June 3, 1896.

The original project, adopted March 23, 1897, based on a survey of the reach made in October, 1896, provides for the expenditure of the allotment of $32,000 from the appropriation of June 3, 1896, in fairing out and protecting the left bank above the site of the proposed bridge, about 3½ miles above Yankton. The work forms part of a general plan, submitted at the same time, for rectification of about 6.5 miles of the river in this vicinity, with a view to restoring the steamboat landing and to controlling the river in the vicinity of the proposed bridge, at an estimated cost of $296,800. As it had become evident in the summer of 1897 that the construction of the bridge would probably not be begun in the near future, a revised project for the expenditure of the allotment was submitted (approved September 3, 1897), providing for beginning the construction of the right-bank group of dikes above Yankton proposed in the general plan for the purpose of restoring the steamboat landing.

To June 30, 1897, $502.71 had been expended. At that date construction work had not been begun, but preparations for it were in progress.

The expenditures during the fiscal year have been $26,555.74.

The plant needed for beginning the work has been procured. Six of the proposed right-bank dikes have been begun, and will be carried out as far as available funds will permit. The erosion of the right bank in the vicinity of the dikes, which was formerly rapid, has been checked, but the dikes have not yet been extended sufficiently to produce any decided change in the position of the channel.

At Elkpoint.—The left bank at this locality was cutting rapidly, and it was feared by the citizens that the town, although nearly 2 miles from the river, was in danger, either by direct erosion of the intervening land or by the river cutting into and occupying an old bed which ran by the town.

No work had been done in this vicinity prior to the act of June 3, 1896.

A survey of the reach was made in October and November, 1896. A project for the expenditure of the allotment of $20,000 from the appropriation of June 3, 1896, was submitted February 8, 1897, providing for protection of the left bank so far as the funds permit. It formed part of a general plan for the protection of about 10,100 feet of the left bank lying in front of Elkpoint.

It was decided that the funds should be retained in the Treasury until such additional appropriation is made as will enable the work to be carried on with safety.

To June 30, 1897, there had been expended $389.24 (for survey). There have been no expenditures during the past fiscal year.

At South Sioux City.—The Nebraska bank of the Missouri River in front of South Sioux City had been protected for about 4,000 feet upstream from the lower bridge and for about 5,400 feet upstream from the upper bridge, by revetments constructed by the owners of the respective bridges. Between these two revetments about 4,270 linear feet of bank was unprotected and was being rapidly eroded. The pres-

ent project, adopted July 24, 1896, contemplates the expenditure of the funds provided by the river and harbor act of June 3, 1896, in revetting this unprotected bank, in repaving the upper bank for 300 feet farther upstream, and in protecting the head of the work by a short pile dike. The project contemplated the expenditure of $50,000, but as it was believed that the work could be done for the $40,000 allotted, no modification of the project was made. The work forms part of a general plan, described under the next heading, for the improvement of the river in this vicinity.

To June 30, 1897, there had been expended $35,674.36. The work had been completed. Its results had been the stopping of the erosion on the formerly unprotected portion of the town front.

The expenditures during the year have been $4,080.48. A combined pile driver and hydraulic grader and four skiffs have been constructed, and a towboat purchased, part of its cost being paid from the allotment for work at Yankton. The plant is intended for use in the lower part of the district as may be required.

The work at South Sioux City remains in good condition, and has protected the front.

At Sioux City.—The river above Sioux City was extremely unstable, several cut-offs had occurred in recent years, causing radical changes in channel, increased slope, and a large amount of erosion on banks opposite Sioux City. For the purpose of checking this erosion, work was begun in 1878 and continued in each succeeding year until 1882. The works constructed were of an experimental type, and have since been destroyed or abandoned by the river.

In 1889, a group of 9 dikes was built at the center of the Sioux City front to check a dangerous erosion and fair out the bank line. In 1895, 2 dikes were built just above this group and 2 dikes of the group strengthened. In the same year, under a project for the expenditure of $40,000 appropriated by the sundry civil act of March 2, 1895, a group of 16 short dikes had been built near the upper limits of the city to protect the bank there. This latter work formed part of a general plan submitted at the same time for the rectification of the river from about 2¾ miles above the mouth of the Big Sioux River to near the lower limits of the city, at an estimated cost for the portion below the Big Sioux River only, of $400,000.

The present project, adopted June 10, 1897, for the expenditure of the $40,000 allotted from the appropriation of June 3, 1896, provides for protecting the lower portion of the city front (below the Floyd River), for making necessary repairs to existing dikes, and for applying the balance to such work as may afterwards be found necessary. The project is a modification of one adopted February 10, 1897, the change having been rendered necessary by marked changes of channel in the spring of 1897. A project providing for the expenditure of $50,000, adopted July 24, 1896, had been superseded by the latter.

To June 30, 1897, $202,250.97 had been expended in this locality.

Under the projects of July 24, 1896, and February 10, 1897, four barges had been built, the dikes near the upper limits of the city had been partially repaired, considerable construction material purchased, and two surveys of the reach made.

The expenditures during the year have been $18,698.97. The Iowa bank has been protected by revetment for 824 feet next below the Floyd River, below which 20 short dikes have been built, and shore protection and foot mattress for 3 other dikes constructed. The mattress for 1 of the latter is an extension of the revetment. It is thought from present conditions that their completion may prove unnecessary,

the mattress laid being a sufficient protection to the bank. By the revetment and dikes the front has been protected for about 7,400 linear feet. The works are in good condition and have thus far fulfilled their purpose.

Ice harbors.—Few good natural ice harbors exist on that portion of the Missouri River known as the "Sandy River," between Carroll, Mont., and Sioux City. The adopted project provides for the construction of two ice harbors, which were afterwards located at Rockhaven, near Mandan, N. Dak., and on the Big Sioux River (upper limits of Sioux City) near its confluence with the Missouri.

The total expenditures to June 30, 1897, were $42,694.19, by which the two ice harbors had been completed.

The expenditures during the year have been $68.56. A well has been driven at the Sioux Ice Harbor for the use of the watchmen and of the force employed on plant repairs. The ice harbors are in good condition as regards shore work, but the removal of bars in their front and at the mouth of the Big Sioux River is frequently necessary to make them accessible.

River survey.—Prior to the adoption of the present project a survey of the entire river, comprising secondary triangulation, levels, topography, and hydrography, had been begun by the Missouri River Commission. Between Fort Benton, Mont., and Sioux City the triangulation had been completed, the primary levels run from Fort Benton to Trover Point, Mont., 232 miles, and topography and hydrography completed from Fort Benton to Coal Banks, Mont., 41 miles.

The present project, adopted December 26, 1890, provides for completion of the survey between Fort Benton and Sioux City, with the publication of maps. The expenditures on the project to June 30, 1897, were $139,250.58. The survey had been completed and mapped and a set of lithographed detail maps, covering the river valley from Fort Benton to Sioux City, had been published.

The expenditures during the year have been $108.20, mostly for freight liabilities of former years. Examinations were made at Fort Benton, Mont., and Judith, Mont., and the water gauges at Wolf Point, Mont., and Fort Buford, N. Dak., the reading of which had been discontinued, were stored.

The total expenditures on the Missouri River between Stubbs Ferry and Sioux City to June 30, 1897, except for snagging, were about $1,294,685.32. In addition, about $10,000 was expended on the general river survey above Stubbs Ferry.

It is understood to be the intention of Congress to continue improvements at Bismarck, Pierre (both sides), Yankton, Elkpoint, and Sioux City (both sides); and for the purpose of economical work at those localities, an estimate of $250,000 is submitted, with recommendation that the allotment of this amount be left to the discretion of the Secretary of War.

COMMERCIAL STATISTICS.

Amount of freight carried on the Missouri River above Sioux City, Iowa.

Calendar year.	Tons.	Calendar year.	Tons.
1887	13,961	1893	19,481
1888	12,895	1894	37,936
1889	16,723	1895	21,264
1890	14,072	1896	10,368
1891	14,211	1897	17,105
1892	17,292		

New lines of transportation were established during the fiscal year 1897. The gasoline boat *Iowa*, of 48 tons, was launched at Sioux City in the fall of 1897, and has since been engaged in the trade between Sioux City and Wheeler, S. Dak., 188 miles.

The steamer *Capitola Butt*, of 57 tons, formerly engaged in ferriage at Sioux City, was sold in the summer of 1897, and has since plied between Chamberlain, S. Dak., and Lower Brulé Agency, S. Dak., 5 miles.

July 1, 1897, balance unexpended	$140,908.73
June 30, 1898, amount expended during fiscal year	90,076.73
July 1, 1898, balance unexpended	50,832.00
July 1, 1898, outstanding liabilities	16,517.02
July 1, 1898, balance available	34,314.98

Amount (estimated) required for completion of existing project:	
Greatfalls to Stubbs Ferry	162,646.50
Greatfalls to Sioux City	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1900	250,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix B B 1.)

2. *Improving Upper Missouri River by snagging.*—In its original condition the "Sandy River" between Carroll and Sioux City was greatly obstructed by snags, and to a less extent by loose rocks.

The original project adopted in 1890 provides for removing the obstructions and the temporary improvement of the worst shoals, at an estimated cost of $50,000 annually. The work, begun in 1891, has been continued in each subsequent year under allotments and appropriations for this purpose.

The expenditures to June 30, 1897, were $317,538.09. Three snag boats had been constructed or purchased, and had been operated as funds permitted. The river had been kept fairly clear of obstructions and the depth over some bad shoals temporarily increased. Extraordinary repairs on one of the boats were in progress.

The expenditures for the year have been $23,393.34, resulting in completing the repairs of one of the boats and in removing in the latter half of 1897 all snags and like obstructions then existing in the channel on the portions of the river most navigated. All the boats were in service, though not constantly, the aggregate time being equivalent to two hundred and six days for one boat. The results were 815 snags and miscellaneous obstructions removed, 153 trees cut on caving banks, and 4,584 miles of river passed over.

July 1, 1897, balance unexpended	$25,535.44
June 30, 1898, amount expended during fiscal year	23,393.34
July 1, 1898. balance unexpended	2,142.10
July 1, 1898, outstanding liabilities	897.39
July 1, 1898, balance available	1,244.71

Amount (estimated) required for work annually	50,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix B B 2.)

3. *Yellowstone River, Montana and North Dakota.*—Originally the channel below Miles City was greatly obstructed by rocks, rapids, bars, and sharp turns, so that navigation was almost impossible at low water

above Glendive and quite difficult below. The original project adopted in 1879 contemplated rock removal and contraction works at shoals and a survey of the river. Since 1884 the work had been limited to the portion between Glendive and the mouth. No work was done under the project after 1885, navigation having ceased.

The total expenditures on the above general improvement were $122,029.59, including cost of surveys, $19,000. The results were to give a low-water depth of 3 feet or more at all points improved, but the works have since deteriorated and these depths do not now exist at all the improved points. The survey was completed.

The present project, adopted October 16, 1896, provides for expenditure of the $10,000 appropriated by act of June 3, 1896, in protecting the right bank in front of Glendive. To June 30, 1897, there had been expended under this project $9,948.69. The work had been completed, and had stopped the erosion of the town front.

The expenditures during the year have been $37.93. The work at Glendive is in good condition and has prevented further erosion.

There has been no commerce on the Yellowstone River in recent years.

July 1, 1897, balance unexpended	$11,771.72
June 30, 1898, amount expended during fiscal year	37.93
July 1, 1898, balance unexpended	11,733.79
July 1, 1898, outstanding liabilities	13.38
July 1, 1898, balance available	11,720.41

(See Appendix B B 3.)

IMPROVEMENT OF CUMBERLAND RIVER, TENNESSEE AND KENTUCKY, AND OF OBION AND FORKED DEER RIVERS, TENNESSEE.

This district was in the charge of Lieut. Col. John Biddle, U. S. Volunteers, captain, Corps of Engineers, to June 1, 1898, and of Maj. Dan C. Kingman, Corps of Engineers, since that date. Division Engineer, Col. J. W. Barlow, Corps of Engineers.

1. Obion River, Tennessee.—This stream flows wholly within the State of Tennessee. It rises in the western part of that State, and running in a southwesterly direction about 75 miles enters the Mississippi, near Hale Point, about 95 miles above Memphis. The head of navigation is Obion, Tenn.

An examination was made in 1880 and an instrumental survey in 1891. The width of the stream varies from 80 to 200 feet; the height of the banks is from 10 to 18 feet above low water; the depth in the pools is generally over 5 feet at low water, but at the shoals a depth of only 18 inches is frequently found. The channel in its original condition was very crooked and greatly obstructed by heavy drift, snags, and overhanging trees, and practically closed above the mouth of Forked Deer River against the smallest steamboats.

The original project, adopted August 3, 1892, sought to secure at low water a navigable channel of not less than 3 feet depth between Obion, Tenn., and mouth of river, about 68.8 miles, by clearing the channel of snags, drift, and overhanging trees; constructing wing dams at the most obstructive shoals; straightening the very tortuous channel by cutting through several sharp bends, and making the cut-offs sufficiently wide and deep by clearing, grubbing, and excavating; closing the old channel by means of pile and brush dams where necessary, at an estimated cost of $50,000.

The original project and estimate were modified June 1, 1897, for the reason that the amount originally estimated, $50,000, is wholly inadequate to produce the results called for in the project as originally submitted; that is, to obtain 3-foot navigation at low water by means of open-channel work. It is doubtful whether this result can be obtained at all by that method (Report Chief of Engineers, 1896, p. 1899), and the project is now limited to the work of removal of such obstructions as prevent navigation and to the maintenance of the channel as improved from year to year. The estimated cost of such clearance and maintenance is about $2,500 per year.

Three appropriations, aggregating $21,000, have been made for this improvement. The amount expended to the close of the fiscal year ending June 30, 1897, was $15,797.01, which was applied to the removal of surface obstructions, principally drift, and has resulted in opening up the river and obtaining comparatively safe navigation to Obion, Tenn., the upper reaches of the river having been closed for more than fifty years.

During the fiscal year ending June 30, 1898, the amount expended was $1,413.27.

Work in channel was begun October 17 and suspended November 30, 1897, and it principally consisted of removing the surface obstructions that prevent navigation in the reach of river about 8 miles below Obion.

Necessary materials have been purchased to build a new derrick boat and quarter boat for joint use upon this stream and the Forked Deer River, as authorized.

All the work upon this stream has been carried on by hired labor, the only method economical and advantageous to the Government and the work.

The commerce of the lower Obion is principally lumber cut by the numerous sawmills on or near the stream and which reaches a market on the Mississippi River. It is impracticable to get complete and accurate commercial statistics of such shipments, because records are not generally kept. So far as can be ascertained, the improvements have given material aid to the lumber interests involved. The commerce reported for the present fiscal year is 18,263 tons, having an estimated value of $68,500. This freight was moved by the steamer *Jas. Laughlin* and three barges, and consisted principally of lumber, a few head of cattle and mules, and general merchandise. The owners of the steamboat report that the stream was navigable a part of January, and from February 1 to May 31.

July 1, 1897, balance unexpended	$5,202.99
June 30, 1898, amount expended during fiscal year	1,413.27
July 1, 1898, balance unexpended	3,789.72
July 1, 1898, outstanding liabilities	160.60
July 1, 1898, balance available	3,629.12
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	2,500.00

(See Appendix C C 1.)

2. Forked Deer River, Tennessee.—This stream lies wholly in the State of Tennessee. The name as here used includes the North and South forks and the main stream formed by their junction.

The North Fork rises in Gibson County and the Middle Fork in Carroll County. These streams unite about 15 miles above Dyersburg, thence, flowing westerly under the name of either North Fork or Middle Fork past that town, joins the South Fork 8½ miles below, thus forming the main stream of the Forked Deer River.

The South Fork rises in McNairy County and flows in a general northwesterly direction for about 250 miles. Jackson, about 148 miles above its junction with the North Fork, is held to be the head of navigation. The stream for some distance below Jackson is very small.

The main stream flows southwesterly and enters into the Obion River 3½ miles above its mouth.

Formerly the Forked Deer River entered the Mississippi through two channels about 18 miles below the present mouth of the Obion River. These outlets, now called "Lost" and "Old" channels, are nearly closed by snags and drifts, but water flows through them during high-water stages in the Mississippi River. About fifty years ago the State of Tennessee cut a canal about three-fourths of a mile long, known as "Tiger Tail," shutting off the former outlet and shortening the Forked Deer River about one-half.

The navigable channel way throughout its entire length, from Dyersburg, Tenn., on the North Fork, and from Jackson, Tenn., on the South Fork, to the Mississippi River was in its original condition greatly obstructed by snags, embedded logs, leaning trees, and large accumulations of drift, the upper sections of the North Fork and South Fork being very crooked and the bends short and numerous. The North Fork below Dyersburg averages 65 feet in width; the South Fork about the same. From the junction of the North and South forks to Key Corner, the last highland on the main river, 11½ miles, the river is from 150 to 200 feet wide, though at several sharp bends it is narrowed to 80 or 100 feet, the channel, however, at these points being generally clear and deep and the banks uniform and unbroken, showing but little erosion. The fall in 20 miles is 6.58 feet. From Key Corner to the Obion River, 9½ miles, with a fall of 15.77 feet, the river flows through the Mississippi bottom lands, shoaling rapidly and being very crooked. The banks are high but alluvial, and therefore subject to heavy erosion. From the mouth of the Forked Deer River to mouth of the Obion River, Tennessee, 3½ miles, there is a fall of 4.20 feet, channel width from 60 to 100 feet, but very deep. The bars at the mouths of the Forked Deer and the Obion form the principal obstructions to navigation of this section.

Four examinations and one survey have been made of the main Forked Deer River and its two navigable branches—the North Fork and the South Fork—during the period from 1873 to 1897.

The original project provided for removing surface obstructions so as to give greater ease and safety to navigation, at an estimated cost of $30,750. By act of July 13, 1892, $3,000 was appropriated for "completing improvement;" consequently at the close of the fiscal year ending June 30, 1897, there was then no existing approved general project for improving the Forked Deer River.

The project originally provided for the same class of channel work upon the main stream and its navigable branches.

The work of improvement was begun in July, 1883.

The amount expended to the close of the fiscal year June 30, 1897, for "maintenance" was $985.36, resulting in thoroughly clearing the channel of the South Fork below Chestnut Bluff of surface obstructions. All work was done by hired labor, the only method practicable upon

this stream. No work was done nor expenditures made for "maintenance" in the fiscal year ending June 30, 1898.

It is estimated that there will be required for "maintenance" of the improved channel of the Forked Deer River and its navigable branches during the fiscal year ending June 30, 1900, the sum of $2,000.

July 1, 1897, balance unexpended	$14.64
July 1, 1898, balance unexpended	14.64
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	2,000.00

(See Appendix C C 2.)

3. The North or Middle Fork of Forked Deer River, Tennessee, from Dyersburg to the Obion River and thence to the Mississippi River.—This stream is locally known as the North Fork, Forked Deer River, and Obion River, having a total length of 33 miles. The Forked Deer River, including the North Fork, has been previously described (see preceding pages), and is here repeated because a separate item of appropriation has been made for the entire stream under the local head of the North Fork, which is only one of the navigable branches of the main river.

A survey was made from Dyersburg, Tenn., to the Mississippi River in 1894, and resurvey in 1897 from Dyersburg to the Obion River. It is held in the reports submitting these surveys that the stream can not be made navigable all the year by means of channel work, and that a permanent low-water navigation is not considered practicable except by means of canalization. A general estimate of $400,000 was made for a slack-water system.

By act of June 3, 1896, $5,000 was appropriated for improving the stream from Dyersburg to the Mississippi River under the general name of North or Middle Fork of Forked Deer River, Tennessee. The approved project for its expenditure is, as provided by said act, to clear the channel of surface obstructions, to reduce bars and shoals at various points so as to deepen the channel and make it navigable for small craft at a 3-foot stage from Dyersburg to the Mississippi River.

The amount expended to close of fiscal year June 30, 1897, was $1,052.94, resulting in reducing bar at mouth of Forked Deer River and removing snags and heavy masses of drift in the lower reaches of the river, and from the main stream to the junction of the North and South Forks.

In the fiscal year ending June 30, 1898, the sum of $1,235.24 has been expended in repairs of boats and in channel work from Dyersburg, Tenn., the head of navigation on the North Fork, to the mouth of the Forked Deer River, about 29½ miles. Work was begun August 9, and the mouth of the river was reached October 16. Snags, logs, leaning trees, stumps, large masses of drift, and surface obstructions generally were removed from the channel. As a measure of economy the same plant and working force are employed upon the Forked Deer and Obion rivers.

The commerce of this stream, so far as can be ascertained, consists almost wholly of logs, lumber, and timber products moved in rafts or flatboats. Some live stock and general merchandise also reach a market by way of the river.

The commerce during the fiscal year, so far as could be ascertained, aggregated 21,363 tons, having an estimated value of $71,000. Passengers carried, 68.

The benefits derived from the improvements are somewhat indefinite. There is no doubt that new timber lands have been opened up and a certain amount of local navigation developed, mostly carrying logs to mills and carrying off the sawed lumber.

July 1, 1897, balance unexpended	$3,947.06
June 30, 1898, amount expended during fiscal year	1,235.24
July 1, 1898, balance unexpended	2,711.82

(See Appendix C C 2.)

4. Cumberland River, Tennessee and Kentucky.—(a) Below Nashville (191 miles).—This section of the river is usually navigable for six months in each year for all steamboats plying upon it; for boats not drawing over 3 feet from six to eight months; for boats drawing 16 inches or less the whole year, though navigation is practically closed for several months during low water.

An examination was made of this section in 1871, and the channel was found to be of the same general character throughout its entire length, obstructed by rock reefs, bowlders, gravel and sand bars, snags, and overhanging trees.

The project based on this examination provided for the removal of the surface obstructions and deepening the channel by excavation and the building of wing dams. This project was supplemented in 1888, on the recommendation of a Board of Engineer Officers, by the proposed construction of a pile dike with crib superstructure for the improvement of the channel at the mouth of the river, from Smithland to the deep waters of the Ohio, for which Congress made provision in river and harbor act of September 19, 1890.

The total amount appropriated under the original project, by acts of 1871 to 1890, inclusive, was $305,000, which has been expended, resulting in lengthening the season of navigation by giving an increased depth at low water and greater security in the passage of obstructions.

A resurvey of the mouth of the river was made in November, 1896, under the provisions of act of June 3, 1896. The report is published in Report of the Chief of Engineers, 1897, pages 2242–2245.

In 1889, under provisions of act of August 11, 1888, a survey was made of the Lower Cumberland River from Nashville to its mouth to ascertain whether necessary to establish locks and dams. On this survey, and estimates submitted therewith, is based the existing project for improving the river below Nashville, consisting of (1) the extension of the lock-and-dam system of the Upper Cumberland to the lower river by the construction of 7 locks and dams, extending from near the mouth of Harpeth River (Lock A) to Big Eddy Shoals (Lock G), the lock chambers to be each 280 feet available length by 52 feet width, the lifts of the lock varying from 8½ to 11½ feet, aggregating about 70 feet; (2) of the improvement of the Kentucky Chute at mouth of river, as recommended by Board of Engineer Officers June 16, 1888 (Report of Chief of Engineers, 1888, p. 1628); (3) of the channel work necessary below Lock G, between Big Eddy Shoals and mouth of river, and (4) snagging and removal of surface obstructions below Nashville. Total estimate of cost of entire improvement, $1,964,500. (Report of Chief of Engineers, 1890, pp. 2151–2161.)

The act of July 13, 1892, appropriated $40,000 for continuing the improvement, including the mouth of the river, and "that $10,000 of this sum, or so much thereof as may be necessary, shall be available for acquiring site and locating lock and dam near the mouth of Harpeth River, Tennessee." This provision forms the initial appropriation for operations under the project or plan as above stated.

Harpeth Shoals are the most formidable obstruction to the navigation of the Lower Cumberland, and to overcome this obstacle the present project has in view that the lock and dam near mouth of Harpeth River, 41½ miles below Nashville, be pressed to completion as rapidly as possible.

Three appropriations, aggregating $150,000, have been made for work under the project for canalization.

The appropriation of June 3, 1896, $80,000, is sufficient only to begin the work of constructing lock and dam near mouth of Harpeth River (Lock A).

The amount expended to June 30, 1897, under present project, was $63,140.67, which was applied principally on account of Lock A, near mouth of Harpeth River, 41.4 miles below Nashville, in the paying for sites for lock and abutment of dam, erecting temporary buildings, constructing cofferdam 700 feet long, clearing sites, right of way and bank at the lock approaches, building landing pier, tramway and gravity incline, opening and stripping quarries, and quarrying and moving stone to lock site; also applied to surveying banks for sites for lock and abutment of Dam B, the second lock of the series. The sites selected are near Hollingsworth Landing, about 51 miles below Nashville. As soon as the maps are completed the sites will be submitted for approval. Surface obstructions were removed from channel below Nashville.

During the fiscal year ending June 30, 1898, the sum of $52,465.66 was expended. The work done was confined to stripping quarry; quarrying and cutting stone for masonry of lock and abutment; repairing the machinery, tram cars, and plant generally; sloping and riprapping bank; cementing cistern for use of the works, and fabricating mooring irons or line hooks to be placed in lock walls. From the material taken out of the quarry there was obtained 9,444 cubic yards of stone suitable for masonry, paving, filling, etc. Transportation between quarry and stone yard is by means of 3-foot gauge tram and gravity track. Two thousand one hundred and nineteen and fifty-three one-hundredths cubic yards of pointed face, special stones, and hollow quoins has been cut. Rough stone selected for backing—5,412 cubic yards— was scabbled sufficient to have good beds. To prevent wash at the junction of cofferdam and bank at upper end, the bank was sloped and riprapped, 1,750 cubic yards of material moved, and 322 cubic yards of riprap placed in position. No channel work was done during the fiscal year.

The U. S. S. *Weitzel* was rebuilt at a total cost of $9,600. A new hull was constructed (130 feet by 24 feet by 3 feet 9 inches), old machinery thoroughly repaired, necessary new machinery and fittings supplied, and all placed in position on new hull, together with an electric plant of sufficient capacity to thoroughly light the boat. After inspection and a satisfactory trial trip the boat was accepted June 25, 1898, and renamed the *Cumberland*. The steamboat will be used on both sections of the river; therefore the cost, as authorized, will be paid equally from the appropriations for the work of improvement above and below Nashville.

The availability or adaptability of the improvement for the purposes of navigation and commerce was not increased at the close of the fiscal year by work done under the existing project, and can not be until Lock A is completed and operated. The cost of maintenance of the river in its present condition, as improved by the open-channel work of past years, is estimated at about $5,000 per annum, which will necessarily be increased as each lock is completed.

The commerce of the Lower Cumberland River during the fiscal year, so far as could be ascertained, consisted principally of grain, coal, logs and lumber, tobacco, hay, live stock, sand, salt, and general merchan-

dise, aggregating 71,674 tons, and having an estimated value of $7,788,530. Passengers carried, 16,085.

July 1, 1897, balance unexpended	$86,859.33
June 30, 1898, amount expended during fiscal year	52,465.66
July 1, 1898, balance unexpended	34,393.67
July 1, 1898, outstanding liabilities	6,147.25
July 1, 1898, balance available	28,246.42
Amount (estimated) required for completion of existing project	1,814,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(*b*) *Above Nashville.—From Nashville to head of Smith Shoals, mouth of Rock Castle River (357 miles).*—This section of the river is usually navigable from Nashville, Tenn., to Point Burnside, Ky., foot of Smith Shoals, for steamboats drawing not more than 3 feet from four to six months of each year; for boats of greater draft from two to three months. The fall is 223 feet, or about 8 inches per mile. From Nashville to Caney Fork River (Carthage, 116 miles) the river is navigable for steamboats of 2½ feet draft from six to eight months, and for those of greater draft four or five months. Steamboats of light draft can ascend to Burkesville, 236 miles above Nashville, for from five to seven months, and larger boats four or five months.

Examinations and surveys were made in 1870, 1874, 1879, and 1880, which formed the basis under which work was done until the adoption of the present project. The nature of the navigable channel way and the obstructions in the river above Nashville is of the same general character throughout, consisting of ledges, gravel and sand bars, bowlders, snags, overhanging trees, and rapid currents, and of mill-dams in the section of the river above the mouth of Jellico Creek. Under the old project $346,000 had been appropriated and expended above Nashville, in open-channel work, resulting in obtaining an increased depth at the principal obstructions and securing a longer and safer period of navigation.

Instrumental surveys were made in 1882 and 1883, which, with accompanying estimates (Report of Chief of Engineers, 1884, p. 1663 et seq.), furnish the basis of the present project for the radical improvement of the Cumberland River.

This project originally provided for the construction of 23 locks and dams between Nashville, Tenn., and Burnside, Ky., and of 7 locks and 2 dams at Smith Shoals, using the river itself as a canal, 1 dam at Mill Shoals, and the other at or near Shadowen Shoals, at an estimated cost of $4,077,922. The project stated that the 23 locks between Nashville, Tenn., and Burnside, Ky., "should be about 60 feet wide and 250 feet between miter sills, though perhaps smaller dimensions would answer the purpose" (Report of Chief of Engineers, 1884, p. 1664), and that the dimensions of the 7 locks at Smith Shoals were to be "55 by 140 feet in the chamber." (Report of Chief of Engineers, 1882, p. 1864.) This project was modified by enlarging the dimensions of each lock-chamber to 280 feet length, 52 feet width, and from 10 to 12 feet lift with 4 feet of water on lower and 5 feet on upper miter sill. (Report of Chief of Engineers, 1888, p. 1623.) The project was further modified as to channel depth by increasing the depth of water to 6½ feet, thus providing for a minimum navigation of 6 feet instead of 4 feet. Approved November 29, 1890. Locks Nos. 2, 3, and 4, as constructed, have a uniform

depth of 6½ feet on the sills. The project was again modified August 12, 1895, by reducing the number of locks on the Smith Shoals section to six.

The present project, therefore, provides for the complete canalization of the Cumberland River from Nashville, Tenn., to the head of Smith Shoals—mouth of Rock Castle River—by a system of lockage, consisting of 29 locks and dams, if that number be necessary, 23 below Burnside, Ky., and 6 above that point—the Smith Shoals section—with a view to secure a minimum channel depth of 6 feet; locks to be each 280 feet long by 52 feet wide, and having from 10 to 12 feet lift, at an estimated cost, as revised, of $8,500,000. (Report of Chief of Engineers, 1896, pp. 1911, 1916.)

The cost of maintenance of the river in its present condition, as improved by open-channel work of past years, including the necessary annual snagging operations, is estimated to be about $5,000 per annum, which estimate will necessarily be increased as each lock is completed.

The amount expended under the existing project to the close of the fiscal year June 30, 1897, was $932,019.15, of which sum $19,366.44 was expended on the account of the Smith Shoals section. This expenditure has been applied to the examination of the river banks for suitable sites, and the purchase of the same for locks and abutments of Dams Nos. 1 to 7, inclusive, and abutment of Dam No. 22, excepting a small tract of 0.36 of an acre required as part of abutment site No. 7; fencing and clearing sites; completing masonry of Locks Nos. 1, 2, 3, and 4, and abutment of Dam No. 1; building lock keeper's house at Lock No. 1; protecting banks at Lock No. 2 by riprapping and paving; building cofferdam, excavating and concreting foundation of chamber of Lock No. 5; purchase and repair of plant; clearing channel of surface obstructions at various times since 1892 from Burnside, Ky., practically the head of navigation, to Nashville, Tenn.

The amount expended during the fiscal year ending June 30, 1898, was $144,891.34, of which amount $886.50 was expended on account of the Smith Shoals section of lockage.

Work done.—Locks Nos. 1, 2, 3, and 4, no active operations in progress. Lock No. 5, operations were carried on during the entire fiscal year. In July and August the work was of a miscellaneous character, moving machinery and sheltering same, prospecting for quarries, clearing United States lands, etc. In September the lock pit was pumped out, and excavation and laying of concrete in the lock chamber was begun. Concreting was finished in October, 638.4 cubic yards having been laid. From October 19 to November 25, 2,094 cubic yards of masonry was laid in the lock walls. Of stone suitable for masonry, 6,888.24 cubic yards was quarried, of which 3,256.24 cubic yards was moved to lock site and 1,789.21 cubic yards cut. Under the provisions of the act of June 4, 1897, the sum of $350,000 was appropriated for continuing improvement by construction of Locks Nos. 5, 6, and 7. This appropriation by authority was allotted for expenditure as follows: For Lock No. 5, $90,000, and for Locks Nos. 6 and 7, $260,000, equally divided. Of the amount allotted for Lock No. 5, the sum of $33,892.58 has been expended. The work was carried on by hired labor and the purchase of supplies under existing regulations.

The U. S. S. *Weitzel* and *Susette* were employed towing stone from quarry to Lock No. 5 and moving heavy supplies from Nashville to the works generally. The U. S. S. *Weitzel* has been rebuilt. The boat has been renamed the *Cumberland.*

Lock No. 6.—On May 4, 1897, a continuous contract was entered into

with McArthur Brothers Company, of Chicago, Ill. Total consideration, $164,871.75.

Work done.—Earth excavation, 993.7 cubic yards; rock excavation, 1,447 cubic yards; approach excavation, rock, 1,106.1 cubic yards; stone filling, 556 cubic yards; cut stone of all classes, inspected and delivered at lock site, 1,579.7 cubic yards; backing, 1,881.8 cubic yards. Total indebtedness incurred under the contract, $37,708.34; amount paid, $29,063.81. Available, $100,936.19.

Lock No. 7.—On May 4, 1897, a continuous contract was made with McArthur Brothers Company, of Chicago, Ill. Total consideration, $181,689.50.

Work done.—Excavation, earth, 768.65 cubic yards; rock, 540.3 cubic yards; cut stone of all classes inspected and delivered at lock site, 2,946.41 cubic yards; backing, 6,701.55 cubic yards. Total indebtedness incurred, $68,766.34; amount paid, $57,785.20. Available, $72,214.80.

The small tract (thirty-six one-hundredths of an acre) needed to complete abutment site was acquired by condemnation, the sum of $32.40 being paid into court April 11, 1898, for the same.

Lock No. 8.—Sites selected for lock and abutment of dam have been approved. The abutment site will probably be acquired by voluntary purchase. Efforts are being made to purchase the lock site in the same manner; otherwise it is proposed to institute proceedings in condemnation.

By act of June 3, 1896, $20,000 was appropriated to be expended in purchasing sites for Locks and Dams Nos. 21 and 22, and in laying masonry for Locks Nos. 21 and 22.

Lock No. 21.—Sites for lock and abutment have been condemned; final action of Department of Justice as to title not yet received.

Lock No. 22.—Sites for lock and abutment have been acquired by the United States.

In view of the small amount of funds available for Locks Nos. 21 and 22 ($18,593.79), in the interest of the work generally, it is preferable, after paying for the sites for both locks, that the masonry of Lock No. 21 be completed before beginning work on Lock No. 22.

In May and June preparations were made to clear the channel of surface obstructions above Nashville, but an unusually low stage of water prevented the snag boat reaching the head of navigation at Burnside, Ky., during the present fiscal year.

Smith Shoals section.—From 1876 to 1882 the sum of $115,000 was appropriated for the improvement of this obstruction, which has been expended in open channel work under the old project. The present project forms part of the general project for improving the Cumberland River above Nashville, Tenn., and originally provided for the construction of seven locks and dams between Burnside, Ky., and mouth of Rock Castle River, a distance of about 30 miles. (See Report of Chief of Engineers, 1891, p. 2270.) Owing to an increase of lift in some of the locks, the number can be reduced to six; therefore the project was modified to that extent; modification approved August 12, 1895.

The amount expended under the present project to June 30, 1897, was $19,366.44, which was applied to survey of river from Burnside to mouth of Rock Castle River, 30 miles, to determine location of the lock and abutment sites, preparation of maps, etc., and in payment of contingent expenses. The sites selected for the six locks and abutments have been approved and authority has been granted to acquire the sites by voluntary purchase preferably, otherwise by condemnation if necessary. Abstracts of titles to the lands sought to be acquired have been

made, showing the record to April 18, 1898, so that action can be taken to obtain the sites as soon as practicable. The amount expended on account of Smith Shoals during the fiscal year ending June 30, 1898, was $886.50.

The availability or adaptability of the improvement for the purposes of navigation and commerce has not been increased by the work done under the existing project, and can not be until a definite section of the river has been canalized and locks put in operation. The present condition of the work by reason of its character and incompleteness is such that it has not at present any appreciable effect upon the object sought to be attained—that is, the opening up of the Upper Cumberland River to navigation—other than that the improved channel already secured has been maintained.

From the conditions on this river no benefit could be derived from the canalization until it be extended at least to mouth of Caney Fork.

The commerce of the Cumberland River above Nashville for the fiscal year consisted principally of coal, sand, live stock, tobacco, grain, logs and lumber, and general merchandise, aggregating 89,776 tons, and having an estimated value of $4,122,900. Passengers carried, 2,930.

The sundry civil act approved July 1, 1898, contains the item of appropriation of $250,000 for improving Cumberland River above Nashville, Tenn.; for continuing improvement by construction of Locks Nos. 5, 6, and 7. This amount is the balance of the $600,000 authorized to be expended for this work under the continuous-contract system or otherwise by river and harbor act of June 3, 1896.

The sum appropriated by sundry civil act of July 1, 1898, will be insufficient to complete the dams, lock gates, etc., for Locks Nos. 6 and 7.

July 1, 1897, balance unexpended		$412,980.85
June 30, 1898, amount expended during fiscal year		144,891.34
July 1, 1898, balance unexpended		268,089.51
July 1, 1898, outstanding liabilities	$9,483.36	
July 1, 1898, amount covered by uncompleted contracts	173,150.99	
		182,634.35
July 1, 1898, balance available		85,455.16

Amount (estimated) required for completion of existing project	7,155,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix C C 3.)

IMPROVEMENT OF TENNESSEE RIVER AND ITS TRIBUTARIES.

This district was in the charge of Maj. Dan C. Kingman, Corps of Engineers. Division Engineer, Col. Henry M. Robert, Corps of Engineers.

TENNESSEE RIVER SYSTEM.

The Tennessee River receives its water from seven different States, and the total area drained by it is, in round numbers, 44,000 square miles. It discharges in time of great floods not less than 700,000 cubic feet of water per second, and at its low-water stages its discharge each second is 10,000 cubic feet.

The Tennessee River and its principal tributaries form a system of internal waterways, capable of being navigated by steamboats, more than 1,350 miles in extent. In addition to this, it is still further navi-

gable by rafts and flatboats for a distance of more than 1,050 miles, thus making a system of navigable water of the United States 2,400 miles in extent.

The river is not navigable during the entire year, but the improvements which have already been made are sufficient to demonstrate that the main trunk of the river can be made navigable throughout the year, and that the useful season of navigation can be greatly lengthened on all of the tributaries. The whole system, on account of the hard bottom of the streams and their stable banks, and from the fact that they are seldom obstructed by ice, is exceptionally susceptible of improvement.

Notwithstanding the many obstructions which still exist in the river and the difficulties and dangers of navigation, there were 63 different steamboats, of an aggregate tonnage of 10,000 tons, and 319 barges, of a carrying capacity of 100,000 tons, employed during the year 1897 upon the system. In addition to these a large amount of lumber was transported in rafts, and a considerable amount of material was moved in flatboats, of which no record could be obtained. The statistics actually collected show that there were transported upon the river during the year above mentioned more than 76,000 passengers and nearly 1,100,000 tons of freight, valued at $14,000,000.

For the purpose of appropriation and administration the river system has been subdivided as follows:

1. Tennessee River.—(a) Above Chattanooga, Tenn. (188 miles).—This section of the river extends from the junction of the French Broad and Holston rivers to Chattanooga. In its original condition it was obstructed by rock reefs, bowlders, gravel bars, and by snags brought down by freshets. The depth of water on the bars varied from 10 inches to 30 inches at low water, and the current was at some places as great as 6 miles an hour. The river was examined in 1830 by Col. S. H. Long, United States Topographical Engineers, and a project for its improvement was prepared. This project proposed to blast a channel through the reefs, reduce the gravel and sand bars, and to deepen the water on the bars by the construction of wing dams and training walls, thus contracting the waterway so as to secure a safe navigable channel 3 feet deep at average low water. No work, however, was done by the United States under this project until 1869, when an allotment of $35,000 was made for improving this portion of the river.

In 1871 another examination was made between Knoxville and Chattanooga, with the result of somewhat increasing the estimates of Colonel Long. Work was carried on under this project until 1893, and a partial improvement was effected at 29 of the 43 obstructions enumerated by Colonel Long in his report of 1830.

The river and harbor act of September 19, 1890, required that a careful and comprehensive survey should be made of this portion of the river and a new project submitted for its improvement. This survey was made under the direction of Col. Henry M. Robert, Corps of Engineers, by Capt. John Biddle, Corps of Engineers, and a report was submitted February 23, 1893, and received Congressional sanction in the river and harbor act of August 18, 1894.

The total amount expended to June 30, 1895, under the original project was $293,255.83.

Since the adoption of the present project to June 30, 1897, $45,832.86 has been expended.

This work has resulted in greatly improving the low-water navigation of the river, and the season of navigation has been materially lengthened.

The commerce on the river has increased, and the cost of water transportation has been reduced. The total value of freight carried on this portion of the river during the calendar year ending December 31, 1897, was $2,693,802.85.

During the fiscal year ending June 30, 1898, the following work was done:

Twelve old bridge piers, constructed of logs and filled with loose stones, were removed from the river near Knoxville. These were the remains of an old military bridge constructed during the civil war by the troops under the command of General Burnside. The stone obtained from these piers was used in repairing the dams and training walls in the vicinity.

At the Marysville Railroad Bridge near Knoxville, the channel was cleared of loose rock, the old dams were repaired and strengthened, and a training wall 350 feet long was built downward from the foot of the island. Three spur dams, of an average length of 130 feet, were connected with the training wall, the object of this work being to equalize the slope and diminish the velocity of the current in the vicinity of the bridge.

At Caney Creek Shoals 2,100 cubic yards of gravel was dredged from the bar near the head of the shoals. The training wall was lengthened 214 feet, the stone being obtained from the quarry previously opened.

A trip was made by the fleet over the river from the junction of the French Broad and Holston rivers, 4 miles above Knoxville, to Chattanooga, a distance of 188 miles. Overhanging trees which interfered with navigation were cut, and snags in the channel removed. To accomplish this work 8,500 leaning trees were felled and 1,018 snags removed.

July 1, 1897, balance unexpended	$21,911.31
June 30, 1898, amount expended during fiscal year	15,004.04
July 1, 1898, balance unexpended	6,907.27
July 1, 1898, outstanding liabilities	438.37
July 1, 1898, balance available	6,468.90
Amount (estimated) required for completion of existing project	585,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	30,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(5) *Below Chattanooga, Tenn. (485 miles).*—The original condition of the river from Chattanooga to Browns Ferry was unfavorable to navigation, the channel being obstructed by rock reefs, bars, bowlders, and projecting rocky points, permitting the passage of vessels from six to nine months annually. From Browns Ferry to Florence it was navigable only at unusually high-water stages, owing to the obstructions known as Big and Little Muscle shoals. Navigation between Florence and Riverton, Ala., was limited to about six months annually, owing to the obstructions known as Colbert and Bee Tree shoals.

The existing project of improvement is as follows:

(1) By blasting and dredging to remove existing obstructions to navigation at Ross Towhead, in the mountain section, at Bridgeport and Guntersville, and elsewhere on the river.

(2) Building a canal 14.5 miles long, 70 to 120 feet wide, and 6 feet deep, to permit navigation past the river obstruction known as Big Muscle Shoals, the canal to have nine locks, each 60 feet wide by 300 feet long, and to cross Shoal Creek by means of an aqueduct 900 feet long

and 60 feet wide. Constructing a canal 1½ miles long to enable vessels to avoid the obstruction known as the Elk River Shoals; this canal to have two locks, one at each end.

(3) Constructing at Little Muscle Shoals a canal about 3 miles long and 6 feet deep, with two locks, each 60 feet wide by 300 feet long, and with 5 feet on the miter sills, at an estimated cost of $1,537,762.

(4) Constructing a canal 8 miles long, 150 feet wide, and 7 feet deep, past the Colbert and Bee Tree shoals obstructions, with one guard lock at the upper end and one lock with 25-foot lift at the lower end; these locks to be 80 feet wide and 350 feet long, and with 6 feet on the miter sills, at an estimated cost of $2,500,000.

(5) Protecting Livingston Point, Kentucky, from destruction by revetments of stone and brush carried well down the bank below the water surface, supplemented by pile and stone dikes. This work is necessary to the preservation of the harbor of Paducah, Ky.

(6) Making a survey of the river from Riverton, Ala., to the mouth, and the removal of snags and other obstructions from the channel.

The total amount expended to June 30, 1897, was $4,438,214.43.

This expenditure had resulted in the completion of the Big Muscle Shoals and Elk River Shoals canals and their approaches at a cost of $3,181,726.50, and in the improvement of Little Muscle Shoals by excavation and the construction of wing dams, whereby its navigation was greatly improved. But as the results show that the requisite depth could not be obtained in this manner, the new project for a canal at Little Muscle Shoals was adopted October 29, 1890.

In like manner the Bee Tree and Colbert shoals were temporarily improved and the season of navigation over them materially lengthened by channel work at a cost of $62,243.41. This was before the adoption of the present project for the lateral canal.

The masonry of the lift lock at Colbert Shoals has been completed, and the right of way for the canal has been purchased and paid for.

During the fiscal year ending June 30, 1898, work of channel improvement, mainly by blasting and dredging, has been done in the mountain section at a point known as the "Skillet," where the river is exceedingly narrow and the fall and current excessive. Over 6,000 cubic yards of loose rock and gravel was removed and the conditions greatly improved. At the "Pot" and "Pan," in the mountain section, a large number of bowlders lying upon the bank, which interferred with the flow of the current and also with the passage of boats at high stages, was drilled, blasted, and removed.

At Williams Island 5,800 cubic yards of rock and gravel was removed by blasting and dredging, and an additional quantity was broken up by blasting but could not be removed owing to the insufficiency of the appropriation.

At Ross Towhead the former work done had not been sufficient to accomplish the degree of improvement required. An area 110 feet wide by 1,100 feet long was drilled and blasted, the material being blue flint of exceeding hardness. The débris so formed was removed by dredging; about 8,000 cubic yards mainly of broken rock was taken away.

The masonry for the lift lock at Riverton was practically completed in the previous year, and a plan had been prepared by a Board of Engineers for the construction of the entrance to the lock. The earth excavation of the entrance was placed under contract, but this work was not completed until too late in the season to permit the construction of

the masonry. The contractor removed something over 60,000 cubic yards of earth, which was placed on the spoil banks south of the lock, and has been so shaped and graded as to form a mound the length of the lock and about 100 feet wide on top. The top of this mound is about 3 feet above extreme high water, and will be used as a site for the lock keeper's house and for such storerooms or tool houses as it may be necessary to build. The surface of the mound has been carefully shaped. Sod has been planted upon it, so as to increase its stability and resistance to water, and to improve its appearance. Three thousand two hundred cubic yards of solid rock was excavated from the entrance, and the material used in the construction of heavy dry stone walls to protect temporary earth slopes at the sides of the cut.

About 1,700 cubic yards of dimension stone was procured by purchase and was transported to the lock site. A new quarry was opened at Cherokee, Ala., which will furnish suitable limestone for the completion of the entrance. Only about 350 yards, however, was taken out and forwarded to Riverton. A great deal of face stone has been cut. Arrangements have been made for the purchase of cement and sand. The materials gathered for the construction of the entrance are worth over $22,000.

Plans have been prepared and submitted for the construction of the guard lock and gates of the Colbert Shoals Canal, and much study has been given to the operating machinery and hydraulic power for the lift lock.

The subject of the disposal of the storm water, which in the natural course would flood the canal, has been carefully considered, and a plan has been submitted and approved.

The volume of the levee between the canal and the river, which forms an essential feature of the project, has been carefully computed, and is found to be greatly in excess of the material which the canal trunk will supply. It will be necessary to determine whether this extra earth required shall be obtained by making the canal wider or deeper than is now proposed, or procured from borrow pits outside the right of way.

In the fall of 1897 a dredging plant, consisting of a dipper dredge with towboat and the proper number of scows, was hired by contract and sent to work at the lower end of the Tennessee River. This was done to determine whether the material could be readily removed in this way, and if the resulting improvement would be reasonably permanent. Work was done at six or seven different points upon the lower 30 miles of the river, and some very bad places were greatly improved.

The dredge, assisted occasionally by surface blasting, was found to be able to remove with ease and economy any of the material there encountered; 29,000 cubic yards of gravel, more or less cemented in its natural condition, was so removed, but it will require soundings to be made at the present low water to ascertain whether the cuts have filled in or not.

The study of the results of the recent survey below Riverton indicates that there are not less than fifty-one places where dredging is necessary, and that this work will require the removal of about 650,000 cubic yards of material, of which about 10 per cent is rock. With this large amount of dredging in prospect it is very desirable that the United States should procure a powerful dipper dredge and a proper equipment of dump scows. The cost of this plant will be about $30,000.

In addition to this work, the United States snag barge belonging to this district was sent over the river from Riverton to Paducah and

return. It removed all snags which could be found and broke up and destroyed a number of other obstructions; 455 snags, 98 stumps, 848 sunken logs, 8 wrecks, 12 bowlders, and other obstructions were removed.

July 1, 1897, balance unexpended		$251,311.60
June 30, 1898, amount expended during fiscal year		115,769.08
July 1, 1898, balance unexpended		135,542.52
July 1, 1898, outstanding liabilities	*$11,723.93	
July 1, 1898, amount covered by uncompleted contracts	3,692.38	
		15,416.31
July 1, 1898, balance available		120,126.21

Amount (estimated) required for completion of existing project	5,362,939.81
Amount that can be profitably expended in fiscal year ending June 30, 1900	1,000,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix D D 1.)

2. Operating and care of Muscle Shoals Canal, Tennessee River.—This canal has been maintained in a state of efficiency and readiness for use throughout the entire year. The number of steamboats and barges that used the canal during the calendar year ending December 31, 1897, was 217, and the freight carried was 5,119 tons, worth $88,565.65. The total number of lockages was 1,842.

The canal is 16 miles in length and has eleven locks. It has a railroad nearly 15 miles in length, and a large number of buildings for the occupancy of the employees of the United States and for other purposes.

The total cost of operating and care for the fiscal year ending June 30, 1898, was $68,868.17. This is a little in excess of the cost of the previous year, but the increase is due to the fact that the lock gates and the steel aqueduct were cleaned and painted. A sand blast was used to remove the old paint and scale, and red lead was applied to the fresh, bright surface of the metal. The dams above the Elk River Division, which had been breached and otherwise injured by the previous flood, were also repaired.

In 1895 authority was given for the construction of a dry dock near Lock No. 6 on the Muscle Shoals Canal, for the purpose of providing a place for the repair of the floating plant belonging to the improvement works of the Tennessee River, one-half of the cost of the same to be charged to operating and care of Muscle Shoals Canal and one half to the general improvement of the river. The dry dock was completed in February, 1897, and since that time has been constantly used in the repair of the Government plant. It is the only dock within a radius of 250 miles, and its use to a limited extent for the repair of private boats would doubtless be of great service to the commercial interests. There is no existing law, however, permitting it to be so used, and I recommend that Congress specially provide that the said dry dock may be used for the examination and repair of vessels for private parties, under such regulations and for such compensation as may from time to time be fixed by the Secretary of War.

(See Appendix D D 2.)

3. French Broad and Little Pigeon rivers, Tennessee.—French Broad River.—This river rises in the western slopes of the Blue Ridge Mountains in North Carolina and enters the State of Tennessee at Paint

* Of the outstanding liabilities $6,022.18 is for wages due during the years 1878 to 1890, which remain unclaimed and probably never will be claimed.

Rock, and after a course of 121 miles in that State unites with the Holston River 4½ miles above Knoxville, thus forming the Tennessee River.

In its original condition the river was obstructed by rock reefs, sand and gravel bars, and also by bowlders, snags, and overhanging trees.

The project for its improvement provides for the removal of all surface obstructions, for the excavation of channels through the reefs and bars, and for the concentration of the water and the regulation of its flow by means of wing dams and training walls, so as to secure a channel depth of 2½ feet at ordinary low water as far as Leadvale, 70 miles from the river mouth.

The amount expended to June 30, 1897, was $67,605.29.

This expenditure resulted in the improvement of navigation below Dandridge, 50 miles, by deepening and clearing the channel, removing the dams constructed for fish traps, constructing wing dams, sills, and training walls, and revetting the banks where necessary. The work in every case, when properly planned, has been singularly successful, and at several points, such as Hanging Rock Shoals, Seven Island Shoals, and Bryant Shoals, which places were formerly almost insurmountable, boats now pass at all stages without difficulty.

The total value of freight carried on the French Broad River during the calendar year 1897 was $617,255.80, which is about ten times the total amount expended on the river since the improvement was begun in 1880.

In the latter part of July, 1897, the fleet belonging to the Upper Tennessee River was sent to the French Broad to carry out such improvement as the funds available would allow.

At Hanging Rock Shoals the dams and training walls were repaired and a portion of caving bank was riprapped; 2,100 cubic yards of stone was used for this purpose.

At Bryant Shoals, near the mouth of the Little Pigeon River, 860 cubic yards of stone and bowlders was removed from the channel.

At Seven Island Shoals 1,700 cubic yards of loose rock was removed from the channel and used in the repair of dams and training walls, and 660 cubic yards of stone was quarried in addition, for the same purpose. A timber crib 728 feet long was constructed to protect the bank of a rapidly caving bend.

At Greens Reef 750 cubic yards of solid rock was drilled, blasted, and removed. And elsewhere along the river at various points 1,250 cubic yards of loose stone was removed from the channel and used in riprapping the banks or repairing and strengthening the dams.

Little Pigeon River.—This river is formed by the junction of its east fork and south fork at Sevierville, Tenn., and flows in a northwesterly direction for about 5 miles, where it empties into the French Broad about 32 miles above Knoxville.

In its original condition it was obstructed by rock and gravel shoals and by rapids.

The project provides for the removal of the bar near the mouth of the river and the removal of the shoal below Catlettsburg, so as to permit light-draft steamers to reach this place.

The amount expended to June 30, 1897, was $1,150.39, which resulted in some improvement of the bar below Catlettsburg, about 90 cubic yards of rock having been excavated from the channel and placed in a riprap dam.

A channel 30 inches deep at low water was dredged through the bar at the mouth of the Little Pigeon; 1,505 cubic yards of loose rock and

small bowlders was removed, and about two-thirds of this was used in riprapping the head of McCroskeys Island, which was rapidly washing away, and the remainder was used for repairing the dam across the island chute.

It is impracticable to separate the freight carried on the Little Pigeon River from that carried on the French Broad, as the same boats are engaged in the trade, and the Little Pigeon practically amounts to an additional landing on the French Broad.

July 1, 1897, balance unexpended	$6,244.32
June 30, 1898, amount expended during fiscal year	5,848.62
July 1, 1898, balance unexpended	395.70
July 1, 1898, outstanding liabilities	131.23
July 1, 1898, balance available	264.47

Amount (estimated) required for completion of existing project	85,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix D D 3.)

4. *Clinch River, Tennessee.*—This river rises in the Cumberland Mountains in Virginia, and after following a southwesterly course empties into the Tennessee River at Kingston, 104 miles above Chattanooga. About 230 miles of the river lies in the State of Tennessee.

In its original condition the channel was obstructed by rock reefs, sand and gravel bars, bowlders, snags, and overhanging trees.

The present project provides for channel excavations, removing surface obstructions, and the construction of wing dams and training walls, so as to secure a navigable channel 2 feet in depth at ordinary low water from the mouth of the river up to Clinton, about 70 miles, and of 1½ feet in depth from Clinton to Haynes, or Walkers, Ferry, about 75 miles. From Haynes Ferry to Osborne Ford, in Virginia, a distance of 120 miles, it is proposed simply to remove the loose rock and bowlders, reduce the rock ledges, remove snags, overhanging trees, and similar obstructions, so as to assist raft and flatboat navigation at the stages at which the river is ordinarily used.

The amount expended to June 30, 1897, was $37,153.20, which resulted in reducing many of the reefs, removing obstructions from the channel, building several wing dams and training walls, whereby the channel was so far improved as to enable the river to be used at stages 2 to 3 feet lower than before the improvement was begun.

The total value of the freight carried on this river during the calendar year 1897 was $903,238.46, which is about twenty-four times the total amount expended on the river since the improvement was begun in 1880.

It is very desirable before going further with the execution of the project that a complete survey of the river should be made and a detailed plan and estimates prepared, in order that it may be known with accuracy how much the improvement will cost and to what extent it will be practicable to carry it.

In July, 1897, a working party of about twenty men was assembled at Osborne Ford, the recognized head of navigation of this river, and descended the river to its mouth, occupying about three months in the trip. On the way down the party improved the channel by the removal of bowlders, gravel, and loose stone, and by reduction, by drilling and blasting, of numerous ledges and reefs. Many overhanging trees were also cut and numerous snags removed. In the execution of this work

about 6,500 cubic yards of large bowlders and reefs was drilled, blasted, and removed; 4,600 cubic yards of stone and gravel was also removed, 300 trees were cut, and 703 snags removed from the channel.

While this work did not include all of a similar nature which might be advantageously and cheaply done, yet it did effect such an improvement as enables the river to be navigated with safety at a lower stage than it could ever be used before. The timber raftsmen, who principally use the upper part of the river, state that they can bring out rafts now upon a foot less water than before this work was done.

July 1, 1897, balance unexpended	$4,346.80
June 30, 1898, amount expended during fiscal year	2,927.98
July 1, 1898, balance unexpended	1,418.82
July 1, 1898, outstanding liabilities	28.84
July 1, 1898, balance available	1,389.98
Amount (estimated) required for completion of existing project	8,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	8,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix D D 4.)

Major Kingman was also charged with the duty of making surveys of the following localities, reports of the results of which will be duly submitted when received:

1. *Tennessee River below Riverton, Ala.*
2. *Elk River, Tennessee.*

IMROVEMENT OF FALLS OF OHIO RIVER, OF WABASH RIVER, INDIANA AND ILLINOIS, OF WHITE RIVER, INDIANA, AND OF TRADEWATER, GREEN, ROUGH, AND KENTUCKY RIVERS, IN KENTUCKY. OPERATING AND CARE OF THE LOUISVILLE AND PORTLAND CANAL, AND LOCKS AND DAMS ON GREEN AND BARRIEN RIVERS.

This district was in the charge of Capt. J. G. Warren, Corps of Engineers, having under his immediate orders Maj. William W. Harts, U. S. Volunteers, first lieutenant, Corps of Engineers, from September 1, 1897, to April 10, 1898. Division Engineer, Col. Henry M. Robert, Corps of Engineers.

1. *Falls of the Ohio River at Louisville, Ky.*—Previous to June 4, 1897, the two divisions of the work of improvement of the falls of the Ohio was provided for by separate appropriations, one of which was applicable to work at the head of the Louisville and Portland Canal, the other to the "Indiana Chute," or channel on the Indiana side of the river. The sundry civil act of June 4, 1897, combined the two projects and provides for work under both under one general head, and in the last annual report the statements of funds pertaining to each were set forth and followed by a money statement for the combined work.

The projects under which work has been and is now in progress are as follows: The original, adopted in 1883 and slightly modified in 1885; the revised, approved January 28, 1890. On the latter date the present plans for improvements on both sides of the river were approved, after having been examined and submitted by a Board of Engineer Officers convened for that purpose. The project pertaining particularly to the enlargement of the easterly end of the canal provides for widening the canal on its northerly side from a point 725 feet below Fourteenth Street Railroad Bridge, where the width of the canal is abruptly increased from 90 to 210 feet. This latter width is gradually increased through a distance of nearly 2,800 feet to 325 feet at the head of the canal proper,

where the enlargement is expanded into a capacious basin 1,200 feet wide and practically parallel to the Kentucky shore.

The Indiana Chute is the main channel of the river over the falls of the Ohio, and originally was very crooked and had irregular rocks projecting from the sides and bottom, rendering it unsafe for navigation except at high stages of water. The object of the project is to so improve the channel, by the construction of dikes, excavation of reefs, etc., as to render it available for descending boats and tows when the river reaches a stage of 8 feet, upper canal gauge.

The object of the improvements on both sides of the river has the same purpose in view, viz, to facilitate the movement of commerce past this point. At present there is not sufficient room at the head of the canal for making or breaking tows preparatory to leaving or entering the canal. This causes much delay to traffic and often results in considerable additional expense, by reason of the fact that tows arriving on a falling stage, and one too low to continue via the Indiana Chute are unable to get the boats through the locks in time to continue their journey before the water reaches a stage too low to float the loaded craft, thus compelling them to lie over and wait for another rise to occur, which involves harboring the boats and consequent expenses. The enlargement at the head of the canal will afford ample room for breaking and arranging tows, enable them to be handled with rapidity and ease, and reduce delay and expense to the movement of commerce to the minimum.

The improvement of the Indiana Chute channel is to afford an open river route for commerce at times when traffic is heaviest and the locks are closed on account of the water reaching a stage of 12.7 feet or more. Eight feet, upper gauge, was adopted as the depth when the open river channel would be available, for the reason that but few tows arrive on a less stage, and consequently these would only be delayed long enough to pass the locks. At stages of 8 feet or more the principal movement of coal and similar bulky and heavy commodities occurs; with the improved channel and a stage of 8 feet or more water, the tows will be able to proceed on their way without delay and expense incident to awaiting their turn for lockage and breaking and rearrangement after passing through the canal.

The total expenditures under these projects to June 30, 1897, were $1,000,763.84. Only portions of the improvements are available at present for the purposes of commerce, on account of their incomplete state. It is worthy of note, however, that the steamer *City of New Orleans*, length 290 feet, tonnage 1,586.28, drawing 5 feet, ascended the open river channel of the "falls" without help, on a stage of 7.8 feet, falls gauge, May 9, 1898.

Expenditures during the past fiscal year amounted to $113,056.79, and were for the completion of the retaining wall at the westerly end of the enlargement at the head of the canal; continuation of the work of drilling, blasting, and removing excavated material south of the new north wall; removal of reefs to grade in the open channel above the railroad bridge, and dike construction at Willow Point.

Statistics of the quantity and character of commerce interested may be seen by reference to the report for "operating and care of Louisville and Portland Canal."

The sundry civil act of July 1, 1898, contains the following item:

Improving Falls of Ohio River at Louisville, Kentucky: For completing improvement, including Indiana Chute Falls, one hundred and sixty-seven thousand two hundred and fifty dollars, of which sum fifteen thousand dollars shall be used for

restoring the levee and banks of the Ohio River at or near Shawneetown, Illinois, recently swept away by the high waters in said river, such sum to be immediately available.

From the above it will be seen only $152,250 of the amount appropriated is applicable to the "falls" projects, and that $15,000 of the estimated cost of work under those projects has been diverted by law to work at Shawneetown; therefore this latter amount ($15,000) is continued in the estimate of amount required to complete, and should, according to custom, be provided in the next sundry civil act passed by Congress.

July 1, 1897, balance unexpended	$359,236.16
Amount appropriated by sundry civil act approved July 1, 1898	152,250.00
	511,486.16
June 30, 1898, amount expended during fiscal year	113,056.79
July 1, 1898, balance unexpended	398,429.37
July 1, 1898, outstanding liabilities	11,905.36
July 1, 1898, balance available	386,524.01
Amount (estimated) required for completion of existing project	89,697.60
Amount that can be profitably expended in fiscal year ending June 30, 1900	90,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix E E 1.)

2. Operating and care of Louisville and Portland Canal, Kentucky.—The present work is the outgrowth of the construction of the canal by a private corporation and its transfer to the United States by authority of Congress in 1874. The canal is about 2 miles long and 90 feet wide; there are two new masonry locks in flight, the chambers of each being 350 feet long and 80 feet wide.

The annual estimates and projects have provided for the operation and maintenance of the canal in good navigable condition, together with such special work as may from time to time be found necessary to make it sufficient to meet the demands of navigation and commerce.

Expenditures from July 1, 1880, when tolls were abolished and the canal became a direct charge on the Treasury, to June 30, 1898, amounted to $1,348,375.84, not including outstanding liabilities.

The canal is available to commerce at all stages of water less than 12.7 feet, upper gauge, and serves its purpose by permitting free navigation around the falls of the Ohio River at stages of water when the passage can not be made by the open river channel.

Expenditures during the fiscal year ending June 30, 1898, were, besides those for ordinary operating expenses, for construction of a combined dredge and derrick boat, for construction of a new hull for the drill boat, for enlargement of coal bin, for construction of two new dump scows, automatic gate, old locks, part of retaining wall, dry dock, etc.

The total expenditures for all purposes during the year were $87,569.12.

The quantity and character of the commerce interested is given in Appendix E E 2 of this report.

The total quantity of commerce passed through the locks during the year was 1,114,991½ tons, an increase of 29,186½ tons over last year.

(See Appendix E E 2.)

3. *Wabash River, Indiana and Illinois.*—In its original condition this river was badly obstructed with shoal bars, accumulations of snags, rock reefs, and numerous secondary channels or cut-offs, which lessened the flow of water through the main channel. There could be no navigation except at high stage of water.

The original project is that submitted by Maj. G. Weitzel in 1872, providing for special improvements at twelve designated points and a general improvement of the river from its mouth to Lafayette, Ind., by means of light-draft boats and dredges, and until March 3, 1881, appropriations were applicable to this whole reach of river. The act of Congress of that date separated the river into two sections, with Vincennes, Ind., as the dividing point. Since then specific appropriations have been made for each section. Otherwise the project has never been amended or revised, notwithstanding the fact that with existing conditions neither it nor the original estimates are applicable or adequate to a systematic improvement of the river.

From the commencement of the work in 1872 to March 31, 1881, the expenditures, all of which were for work below Vincennes, amounted to $324,845.44. Since March, 1881, expenditures for each section of the river are given below separately:

(*a*) *Below Vincennes.*—From March, 1881, to June 30, 1897, expenditures for work below Vincennes amounted to $362,985.65, including $25,000 expended for levee work at Irayville, Ill. From 1884 to the present year the greater part of the appropriations for "below Vincennes" has been applied to the construction of a masonry lock and timber dam with masonry abutments and timber guide cribs at Grand Rapids. The lock, dam, abutments, and guide cribs have been completed. Since the operations and funds have been concentrated to complete the structures just mentioned, and necessarily suspended elsewhere on the river, the improvements at other places have rotted away or been damaged by ice and freshets. High water has cut its way around them, leaving the river as badly obstructed as it was before its improvement was commenced, and with no permanent improvements to its navigation and commerce other than the channels cut through solid rock and the lock and dam at Grand Rapids, which latter will be of little benefit unless the river is improved in such manner as to enable boats to reach that point. Therefore, considered as an entirety, this section of the river at a normal stage is not available for navigation. The obstructions now existing present no unusual features to indicate that they would be difficult to overcome, and with sufficient funds for regular and continuous operations the river could be easily adapted to the requirements of commerce. The improvement, however, should begin at the mouth of the river and be carried continuously up stream. Expenditures during the year amounted to $6,810.07, and were for the completion of the guide cribs below the lock at Grand Rapids and for examinations of the river between that point and its mouth, including a survey of the cut-off at New Harmony, Ind., which was found to be the worst obstructed portion of the river, the conditions at that point being such as to practically cut the navigation of the river in two. A careful survey of the cut-off has been made, the details of which, together with the outlines of an approved plan for work at this point, estimated to cost $60,000, will be found in Appendix E E 3. A detailed discussion of the present condition of the river and of what is required for its improvement so as to be beneficial to navigation and commerce will also be found in that appendix.

July 1, 1897, balance unexpended	$7,168.91
June 30, 1898, amount expended during fiscal year	6,810.07
July 1, 1898, balance unexpended	358.84
July 1, 1898, outstanding liabilities	25.75
July 1, 1898, balance available	333.09
Amount (estimated) required for completion of existing project	60,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(*b*) *Above Vincennes.*—Since this part of the river has become the object of specific appropriations the sum of $89,287.39 had been expended to June 30, 1897. Formerly a fairly good channel 3 feet in depth was maintained, but for several years past the appropriations have been too small to permit of other than snagging operations at irregular intervals. The channel at present is only available for navigation at the higher stages of water. At low water the numerous snags, bars, and secondary channels render navigation—even with the lightest draft boats—extremely uncertain. The only operations in progress on this reach of river during the fiscal year was a short period of snagging work done with a snag scow which was towed to Terre Haute, Ind., and then worked down stream by a crew consisting of a master laborer, hoisting engineer, cook, and eight laborers. No regular line of steamboats operate over this section of the river. The only traffic is during high stages of water, when a few light-draft boats make irregular trips to transport corn, wheat, oats, and similar commodities to the nearest railway for reshipment.

July 1, 1897, balance unexpended	$2,212.61
June 30, 1898, amount expended during fiscal year	1,873.91
July 1, 1898, balance unexpended	338.70
Amount (estimated) required for completion of existing project	4,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	4,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix E E 3.)

4. *Operating and care of lock and dam at Grand Rapids, Wabash River.*—This lock and its dam were built from funds derived from appropriations for improving Wabash River, Indiana and Illinois. The operating expenses were also paid from that appropriation until March 1, 1897, since which date they have been paid from allotments from the indefinite appropriation for operating and care of canals and other works of navigation, act of July 5, 1884. The annual projects and estimates provide for the operation of the lock and such repairs thereto and the appurtenant structures as may be necessary to maintain them in good condition. From March 1, 1897, to June 30, 1897, the expenditures amounted to $166.75.

The expenditures during the fiscal year ending June 30, 1898, amounted to $539.15, and were for the lock tender's salary, repairs and repainting lock gates, signal lights, clearing lock chamber of deposits, etc.

(See Appendix E E 4.)

5. *White River, Indiana.*—Originally this river was, throughout the entire reach embraced within the project, badly obstructed by rock

reefs, shoals, remains of old structures, and a very great number of snags. It could be navigated only during high stages of water.

The original project is based upon the report of examinations of the White River and its forks, Indiana, submitted December 31, 1878, by Maj. Jared A. Smith, Corps of Engineers, and the first provision for improvement was made in the river and harbor act of March 3, 1879. The object was to provide a channel as far as might be practicable "without constructing locks and dams." A depth of 2 feet is indicated, but no definite minimum of channel was specified. In this project, which has not been amended or revised, the estimated cost was $150,000. The act of August 18, 1894, provided for a resurvey of the river. For detailed report of this survey and estimate of cost of improvements, together with recommendations, see pages 2483–2504, Report of the Chief of Engineers for fiscal year ending June 30, 1897.

The funds available were not sufficient for any operations during the year.

The total expenditure to June 30, 1897, is $119,188.26. The lower 13 miles of the river is navigable for boats drawing 3 feet; above this to the junction of the two forks and about 5 miles up East Fork boats drawing 18 inches can navigate about one month of the year. Low-water navigation on the forks is impracticable, and the better portion of the river will soon become full of snags.

July 1, 1897, balance unexpended	$811.74
June 30, 1898, amount expended during fiscal year	107.92
July 1, 1898, balance unexpended	703.82

(See Appendix E E 5.)

6. Tradewater River, Kentucky.—This river, before any improvement work was commenced, was practically closed by a rock bar near its mouth, and higher up by logs, snags, drift piles, leaning trees, and bars.

The project, adopted in 1881, provides for clearing the river and its banks of obstructions and opening a channel 40 feet wide and 2½ feet deep during six months of the year, the improvement to extend 41 miles up stream from its mouth in the Ohio River.

Up to June 30, 1897, $16,068.48 had been expended, resulting in securing a channel through the rock bar at the mouth of the river and in removing obstructions from the channel and banks throughout the distance mentioned in the project. However, no work has for several years been done toward keeping the stream clear of snags. A report of a recent examination of the river will be found on pages 2476–2483, Report of the Chief of Engineers for the fiscal year ending June 30, 1897. No work was done during the year on account of lack of funds.

July 1, 1897, balance unexpended	$431.52
July 1, 1898, balance unexpended	431.52

(See Appendix E E 6.)

7. Lock No. 2, Green River, at Rumsey, Ky.—The deficiency act approved March 3, 1893, appropriated $65,000 for rebuilding this lock, which in 1892 was reported unsafe for navigation.

The project for the work, approved in 1893, calls for the construction of a new lock on the river side of the old lock, with certain changes of existing conditions to make them conform to the location of the new lock.

The amount expended to June 30, 1896, was $160,079.74, and resulted in the completion of the new walls, gates, etc., and dredging approaches, and the resumption of navigation through the new lock on December 8, 1895. Guide cribs above the lock remain to be constructed and a portion of the grading is yet unfinished, but the funds on hand are believed to be sufficient and no further appropriation is necessary.

July 1, 1897, balance unexpended	$9,920.26
July 1, 1898, balance unexpended	9,920.26

(See Appendix E E 7.)

8. *Green River, above mouth of Big Barren River, Kentucky.*—The river above slack water afforded by Dam No. 4, Green River, is obstructed by snags, overhanging trees, bowlders, etc., which, under the decision that present funds are applicable only to the construction of Lock No. 5, it has not been possible to remove. It is recommended that future appropriations be so worded as to permit the necessary work of clearing the pool being done. This could be accomplished by making the appropriation title read: "Improving Green River, Kentucky, above mouth of Big Barren River, continuing improvement;" or, if Congress at its next session defers further appropriation, then it is recommended that the funds at present available be made applicable to the work of clearing the pool above Lock No. 5, which work can be done not only more readily and economically before the pool level is increased by the completion of the lock and dam, but can be done most advantageously at intervals when the plant now on hand can be spared for that purpose from other parts of the district.

The originally adopted project for the improvement of this portion of Green River, Kentucky, is contained in the report and project submitted by Maj. D. W. Lockwood, Corps of Engineers, under date of August 11, 1891, and provided for the extension of slack-water navigation from the upper limit of Pool No. 4 to Mammoth Cave, Kentucky, by the construction of two locks and dams, the combined lift of both aggregating 27 feet. The estimated cost of each lock and dam was placed at $180,673.20, or a total estimated cost of the whole project as $361,346.40

The project and estimate have not been modified, excepting as modified by the following act of July 13, 1892:

Improving Green River, Kentucky, above the mouth of the Big Barren River: For Lock No. 5, according to report and recommendation of Major D. W. Lockwood, Corps of Engineers, United States Army, submitted August 11, 1891.

This practically reduced that project to one-half its original extent and the amount of the estimate to that required for one lock and dam; hence in the money statement below the "amount (estimated) required for completion of existing project" is the unappropriated balance of the estimated amount required for the completion of only one of the locks and dams contemplated in the project as originally submitted.

The expenditures to June 30, 1897, aggregating $16,549.05, were for the necessary land on the lock side of the river, the construction of a lock-tender's dwelling, temporary store sheds, shops, etc., and purchase of materials for the construction of the lock, and excavation for foundation of lock.

The work is not available for the purposes of navigation on account of its incomplete state. The foundation and land wall of the lock were completed during the year, leaving the river wall, gates and operating devices, guide cribs, and dam to be constructed.

July 1, 1897, balance unexpended	$78,450.95
June 30, 1898, amount expended during fiscal year	64,845.21
July 1, 1898, balance unexpended	13,605.74
July 1, 1898, outstanding liabilities	158.17
July 1, 1898, balance available	13,447.57
Amount (estimated) required for completion of existing project	85,673.20
Amount that can be profitably expended in fiscal year ending June 30, 1900	85,673.20

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix E E 8.)

9. Operating and care of locks and dams on Green and Barren rivers, Kentucky.—Originally the locks and dams in these rivers were built by the State of Kentucky. When the United States acquired possession of these river improvements, December 11, 1888, navigation of the system was broken at Lock No. 3, Green River, the river wall at that lock having fallen into the river; the lower end of the land wall at Lock No. 1, Barren River, was badly cracked and liable to fall at any time, and both walls at Lock No. 2, Green River, were in a dangerous condition. The channels of the pools were much obstructed by snags and landslides.

Since the United States acquired control unobstructed navigation throughout the entire system has been restored by either extensive repairs or new work. The expenditures for repairs, operation, and maintenance to June 30, 1897, aggregated $655,600.72. During the fiscal year ending June 30, 1898, the expenditures amounted to $64,779.61, and were for the operation and maintenance of the several locks and dams and working plant, including the construction of a concrete reinforcement to the lower end of the river wall at Lock No. 4, Green River, and the reconstruction of a portion of the dam at Lock No. 2, Green River. The completion of the latter work will be effected during the present season.

Statements of traffic and commerce through the locks will be found in Appendix E E 9 of this report.

(See Appendix E E 9.)

10. Rough River, Kentucky.—In its original condition the river was very much obstructed by overhanging trees on the banks and by snags, logs, and bowlders in the bed of the river. The lower 8 miles of the stream is affected by backwater from the Rumsey Dam (No. 2) on Green River, but above this the stream had but little depth at low water.

The project for improvement, adopted in 1890, is to clear the river of obstructions and locate and construct a lock and dam near the site of the old ones, so as to carry slack water to Hartford, Ky.

The amount expended to June 30, 1897, was $92,737.56, and has resulted in the completion of the lock and dam and clearing the channel of obstructions throughout the distance covered by slack water.

The only work during the year consisted of a period of sixty-nine days' snagging operations and the construction of a fence to inclose the lock grounds. The completion of the lock and dam provides water transportation to Hartford, Ky.

The unexpended balance is sufficient to complete the work remaining to be done under the project.

July 1, 1897, balance unexpended	$12,762.44
June 30, 1898, amount expended during fiscal year	1,687.95
July 1, 1898, balance unexpended	11,074.49
July 1, 1898, outstanding liabilities	17.27
July 1, 1898, balance available	11,057.22

(See Appendix E E 10.)

11. Operating and care of lock and dam in Rough River, Kentucky.—This lock and dam were built from funds provided in appropriations for improving Rough River, Kentucky, and opened to navigation December 12, 1896, and the expenses of its operation and care since July 1, 1897, paid for from the indefinite appropriation for operating and care of canals and other works of navigation.

The annual project and estimate for the past year provided for nothing further than the operation and care of the lock and current repairs incident thereto. The expenditures during the year amounted to $859.08.

The lock affords slack-water navigation to Hartford, Ky. The channel of the river above the lock was cleared of snags and other obstructions at the expense of the appropriation for "improving Rough River, Kentucky."

(See Appendix E E 11.)

12. Kentucky River, Kentucky.—At the time the project was adopted, in 1879, the five locks and dams built by the State of Kentucky many years ago were in a dilapidated condition and had been practically abandoned and allowed to go to ruin by the State. The channel was also much obstructed by snags and leaning trees. Portions of dams Nos. 1 and 2, in the lower part of the stream, were gone entirely, so that navigation was suspended.

The original and present project was adopted in 1879 (report printed in the Annual Report of the Chief of Engineers for 1879, pp. 1398–1422) and provided for repairing and rebuilding the five old locks and dams, removing snags, logs, and other obstructions, and extending 6 feet of slack-water navigation up the stream to Three Forks, a distance of about 261 miles from the mouth of the river in the Ohio at Carrollton, Ky.

The amount expended to June 30, 1897, was $1,687,339.62, and resulted in repairing and rebuilding the five old locks and dams originally constructed by the State; the construction and completion of Lock and Dam No. 6, with their appurtenances, extending slack-water navigation up to Highbridge, Ky., 121 miles above Carrollton, Ky., and the partial construction of Lock No. 7, a short distance below Highbridge. The amount expended during the fiscal year ending June 30, 1898, $63,023.96, was for labor and material for the completion of Lock No. 7, its dam, and their appurtenances, and the greater portion of the work of grading the adjoining grounds. The completion of this lock, which was opened to navigation in December, 1897, extends slack-water navigation to Little Hickman, Ky., a distance of 139 miles above the mouth of the river at Carrollton, Ky.

For several years past the necessity for a revision of the amount (estimated) required for the completion of the existing project has been apparent. A full discussion of this subject will be found in Appendix E E 12 of this report, in which will also be found commercial statistics pertaining to the improved portion of the river.

July 1, 1897, balance unexpended	$268,660.38
Amount appropriated by sundry civil act approved July 1, 1898	350,000.00
	618,660.38
June 30, 1898, amount expended during fiscal year	63,023.96
July 1, 1898, balance unexpended	555,636.42
July 1, 1898, outstanding liabilities	210.11
July 1, 1898, balance available	555,426.31

Amount (estimated) required for completion of existing project	716,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	300,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix E E 12.)

13. Operating and care of locks and dams in Kentucky River, Kentucky.—At the time the United States acquired possession of the five locks and dams in this stream in 1880, consequent to the report printed in Annual Report of the Chief of Engineers for 1879 (pp. 1398–1422), navigation was practically suspended on account of the fact that the works required repairing and rebuilding. These five locks and dams were built by the State of Kentucky in 1835–1839, and from 1880 up to 1885 were extensively repaired by the United States under appropriations for improving Kentucky River, Kentucky. Since then Locks and Dams Nos. 6 and 7 have been built and added to the system. The annual estimates and projects for the operation and care have provided for the operation and maintenance of the system in good navigable condition. Expenditures under the indefinite appropriation for such expenses to June 30, 1897, amounted to $662,261.75. The expenditures during the fiscal year ending June 30, 1898, were for payment of lock-tenders' salaries; operating the towboat and dredges in keeping the locks and entrances clear of deposits, snags, etc.; repairs to the dams, crib work, and other structures at the several locks, and repairs to the dredging and snagging outfit, and amounted to $49,084.03, not including $4,111.72, outstanding liabilities June 30, 1898.

(See Appendix E E 13.)

IMPROVEMENT OF OHIO RIVER AND OF MUSKINGUM RIVER, OHIO, OF NEW RIVER, VIRGINIA AND WEST VIRGINIA, AND OF CERTAIN RIVERS IN WEST VIRGINIA AND EASTERN KENTUCKY.

This district was in the charge of Maj. W. H. Heuer, Corps of Engineers, to October 6, 1897, and of Maj. W. H. Bixby, Corps of Engineers, since that date, these officers having under their immediate orders Lieut. William B. Ladue, Corps of Engineers, from August 13, 1897, to April 11, 1898. Division Engineer, Col. Henry M. Robert, Corps of Engineers.

1. Ohio River.—The Ohio River from Pittsburg, Pa., to its mouth in the Mississippi, near Cairo, Ill., has a length of about 1,000 miles. Its total drainage area is about 210,000 square miles. The total population of the cities and towns situated immediately upon the banks of the Ohio and its principal tributaries is, in round numbers, 1,800,000 (Census of 1890).

Original condition.—The first work to improve the navigation of the river was done in 1825. At that time the river was obstructed throughout its entire length by snags, rocks, and gravel and sand bars, and navigation at low stages was exceedingly difficult and dangerous.

Project.—The general project which has been followed since work was first commenced on the river is to secure additional low-water depths

at islands and bars by the construction of low dams across chutes, by building dikes where the river is wide and shallow, by dredging, and by the removal of rocks and snags.

A modification of this project for a portion of the upper part of the river has been approved and the radical improvement of this stretch of river undertaken by the construction of a series of locks and movable dams. The first of the series is at Davis Island, 4½ miles below Pittsburg, and has been in successful operation since 1885.

The amount expended up to the close of the fiscal year ending June 30, 1897, was $5,706,632.32.

The work accomplished up to that date has been of great benefit to navigation, but at many localities good. results can only be obtained by a large expenditure, and the small amount available yearly for the whole river prevents much desirable work of improvement.

The work done during the year is as follows:

Bank protection at Davis Island; repair of dam between Davis and Neville islands; dredging of bars at Raccoon, Rising Sun, Craigs, Flint Island, and Paducah, and for improving harbors of Golconda and Brooklyn, Ill., and Madison, Ind.; completing loose-stone dikes at Craigs and French Island, and building short spur dikes at Blennerhassett Island. In addition to work by U. S. snag boat, 16 coal-boat and barge wrecks were removed from the channel near Pittsburg; 2 wrecks at Mount Vernon, Ind.; 104 snags at Craigs Bar; 118 snags and 60 cubic yards rock between Pomeroy, Ohio, and Lawrenceburg, Ind. The levee at Shawneetown was strengthened with 2,000 cubic yards earth filling. Dike work and bank protection at Evansville, under contract, was practically completed.

Operations of United States dredges.—This plant was employed at Craigs and Rising Sun bars and in the harbor of Madison, Ind., and during the fiscal year removed 159,123 cubic yards material and 106 snags.

Harbor lines.—Field work in establishing permanent reference points of the lines at Pittsburg, Wheeling, and Cincinnati was carried on at various times for five months, special attention being given to encroachments, of which about 54 were reported, and the parties warned of legal prohibitions. Office work on harbor lines was continued most of the year.

Survey, Marietta to Pittsburg.—Field work was completed October 4, 120 miles of river having been surveyed during the year. Work on the maps was continued to the end of the year.

Commerce.—The total amount of freight transported during the calendar year was 11,265,638 tons; passengers, 1,914,763.

No new lines of transportation have been established that would materially affect the aggregate commerce of the river.

During the season of 1897 navigation was almost suspended for about two months by extreme low water, but not at all by ice.

In general terms, the object of the work now being done and that projected on the river is to secure, as nearly as may be, uninterrupted navigation during the whole year with a minimum low-water channel depth of 6 feet.

The maximum draft that can be carried June 30, 1898, at mean low water over the shoalest part of the river may be stated as follows:

	Feet.
Cairo to Evansville	5
Evansville to Louisville	4
Louisville to Wheeling	3
Wheeling to Davis Island Dam	2
Davis Island Dam to Pittsburg	6

The total amount expended on the improvement of the river for the last seventy years is not more than 2½ per cent of the value of the commerce carried on the river in a single year.

The work heretofore done has undoubtedly been of the greatest utility in lessening the danger and difficulty of navigation and as a safeguard to commerce, but the capacity of the upper river can only be fully developed by a continuation of the system of movable dams begun below Pittsburg.

July 1, 1897, balance unexpended		$296,409.72
Amount appropriated by sundry civil act approved July 1, 1898		* 15,000.00
		311,409.72
June 30, 1898, amount expended during fiscal year		115,896.41
July 1, 1898, balance unexpended		195,513.31
July 1, 1898, outstanding liabilities	$12,266.41	
July 1, 1898, amount covered by uncompleted contracts	6,953.15	
		19,219.56
July 1, 1898, balance available		176,293.75
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		500,000.00

(See Appendix F F 1.)

2. Operating snag boat on the Ohio River.—The condition of the channel way of the Ohio, the necessity for continuous snag-boat work, and the benefits accruing therefrom to river commerce are plainly shown by the yearly reports of obstructions removed, which, if permitted to remain, would make navigation highly dangerous at ordinary stages and hazardous at any time.

The project for removing obstructions by a properly equipped snag boat was put in operation in 1876, when the boat was completed at a cost of $125,125.24, the expense of operating being borne by appropriations for improving the Ohio River until 1890, when the river and harbor act provided $25,000 yearly for this purpose; by the act of June 3, 1896, the yearly appropriation was increased to $50,000.

The amount expended on this work up to the close of the fiscal year ending June 30, 1897, was $164,166.29.

As far as practicable removal of obstructions is carried on whenever the stage of water will permit, except in the months when the safety of the boat would be endangered by ice. This work, in connection with the occasional hire of boats when the snag boat is not available, maintains a channel as nearly unobstructed as possible, the chief object in view being to remove wrecks as soon as practicable after the limit of time permitted by law.

The amount expended during the year was $21,412.08.

(See Appendix F F 2.)

3. Operating and care of Davis Island Dam, Ohio River, near Pittsburg, Pa.—This dam is the first of the series for the improvement of the upper portion of the river, and it has been in successful operation since 1885, proving a great benefit to commerce.

The amount expended up to June 30, 1897, was $195,814.23, in operating and keeping the work in repair.

During the year the dam was raised six times and lowered five. The new steel lock gates are a success, but the valve-operating device

* For work at Shawneetown, Ill.

requires some modification. Two additional boilers were set up for use at these gates. There was no interference with navigation caused by the structures. The cost of operating and care of lock and dam during the fiscal year ending June 30, 1898, is $9,504.68.

(See Appendix F F 3.)

4. Movable Dams Nos. 2, 3, 4, 5, and 6 in the Ohio River.—For 50 miles or more below Pittsburg the narrow channel of the Ohio River is so greatly obstructed by islands and shoals that navigation for ordinary vessels is much interrupted and only possible for the numerous coal fleets of this section in flood stages. The movable dam at Davis Island (completed in 1885) has greatly relieved these conditions near Pittsburg, but it is evident that the only method of securing the desired results is by a continuation of this system.

The construction of Dam No. 6, now building, was ordered by the river and harbor act of September 19, 1890, without previous report or estimate. It is assumed that Congress adopted the report of a Board of Engineers dated November 27, 1888, in which the cost was estimated at $900,000. The special projects were approved as follows: Preliminary, September 27, 1890; lock, June 16, 1892, at an estimated cost of $305,718.75; Chanoine dam across navigable pass, June 10, 1896, contract price, $90,923.89.

A special project for closing the gap between the navigable pass and the left bank by three bear-trap dams was also approved July 27, 1897, but work under it was not begun, and a modified project for this purpose was recently submitted and considered by a Board of Engineers.

The act of June 4, 1897, appropriated $300,000 to complete Movable Dam No. 6.

The amount expended up to the close of the fiscal year ending June 30, 1897, was $490,120.84.

Word on the lock during the year comprised the timber facing of the lower and part of that for the upper guiding wall, some concrete work, and about 7,000 cubic yards excavation in the approaches to the lock. The lock is practically completed, except the gates and operating machinery.

Work on the Chanoine dam was begun in June, 1897, and continued until the middle of November, when, owing to its slow progress, the Government, under the provisions of the contract, assumed charge and has conducted all operations since that date. The principal work accomplished was all excavation for foundations, all piling for grillage, sheet piling on upstream side of concrete for a length of 500 feet, and concrete laid, within 6 inches of required depth, for a distance of 336 feet.

The construction of Dams Nos. 2, 3, 4, and 5 was provided for by the river and harbor act of June 3, 1896, which appropriated funds for the purchase of the sites "in accordance with the project submitted February 3, 1896," by which project (see Annual Report, 1896, Part IV, p. 2120) the estimated cost of the dams was placed at $750,000 each, making a total estimated cost of $3,000,000.

Further provision was made in the act of June 3, 1896, for the completion of the dams by the continuous-contract system, at a cost not exceeding $2,000,000, being $1,000,000 less than their estimated cost. The act of June 4, 1897, appropriated $400,000 for work on Dams Nos. 2, 3, and 4, and authorized contracts to be let for so much of the work on Dams Nos. 2, 3, 4, and 5 as could be done within the $2,000,000 limit, but restricting the yearly payments to 25 per cent of the whole amount authorized to be expended—that is, to $500,000 per year.

The sundry civil act approved July 1, 1898, appropriates for continuing construction of Dams Nos. 2, 3, 4, and 5, between Davis Island Dam and Dam No. 6, $595,000.

A special project for Lock No. 2 was approved by the Secretary of War July 28, 1897. A modification of the lock floor proposed in this project was approved September 20, 1897. Subsequently, as it appeared that Congress by its action intended that continuing contracts covering all these works should be arranged for immediately, the specifications were ordered to be amended so as to include Locks Nos. 3, 4, and 5. Contracts were accordingly made in December, 1897, and work on Nos. 2 and 4 begun in April, 1898. Nothing can be done at Nos. 3 and 5 until the sites are acquired.

The purchase of all other land required for sites is completed.

The amount expended on Dams Nos. 2, 3, 4, and 5 up to the close of the fiscal year ending June 30, 1897, was $7,058.79.

Commercial statistics are appended to the report for improving Ohio River.

CONSOLIDATED.

July 1, 1897, balance unexpended		$832,820.37
Amount appropriated by sundry civil act approved July 1, 1898		595,000.00
		1,427,820.37
June 30, 1898, amount expended during fiscal year		90,188.90
July 1, 1898, balance unexpended		1,337,631.47
July 1, 1898, outstanding liabilities	$7,781.13	
July 1, 1898, amount covered by uncompleted contracts	882,125.41	
		889,906.54
July 1, 1898, balance available		447,724.93
Amount (estimated) required for completion of existing project		1,975,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900		497,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

DAMS NOS. 2, 3, 4, AND 5.

July 1, 1897, balance unexpended		$429,948.61
Amount appropriated by sundry civil act approved July 1, 1898		595,000.00
		1,024,948.61
June 30, 1898, amount expended during fiscal year		24,169.07
July 1, 1898, balance unexpended		1,000,779.54
July 1, 1898, outstanding liabilities	$676.83	
July 1, 1898, amount covered by uncompleted contracts	823,305.70	
		823,982.53
July 1, 1898, balance available		176,797.01
Amount (estimated) required for completion of existing project		(*)
Amount that can be profitably expended in fiscal year ending June 30, 1900		(*)
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

* See amounts given for these items in the consolidated statement above.

DAM NO. 6.

July 1, 1897, balance unexpended		$402,871.76
June 30, 1898, amount expended during fiscal year		66,019.83
July 1, 1898, balance unexpended		336,851.93
July 1, 1898, outstanding liabilities	$7,104.30	
July 1, 1898, amount covered by uncompleted contracts	58,819.71	
		65,924.01
July 1, 1898, balance available		270,927.92

(See Appendix F F 4.)

5. *Muskingum River, Ohio.*—Many repairs and some reconstruction work was necessary when the United States assumed charge of the slack-water navigation on the Muskingum River, in 1887. This report is limited to work carried on under an appropriation of $102,000 by act of August 11, 1888, for the construction of a lock at Taylorsville and the reconstruction of the lock at Zanesville, Ohio. This latter work was indefinitely postponed, and Congress diverted to other purposes the money originally appropriated for it.

The amount expended up to the close of the fiscal year ending June 30, 1897, was $96,379.57. Work under this appropriation is completed, except the construction of a lock house at Marietta, Ohio, and the cleaning up of grounds at site of lock, this having been postponed awaiting acquisition of land, whose grant is now under consideration by the State legislature.

July 1, 1897, balance unexpended	$5,620.43
June 30, 1898, amount expended during fiscal year	54.19
July 1, 1898, balance unexpended	5,566.24
July 1, 1898, outstanding liabilities	2.25
July 1, 1898, balance available	5,563.99

(See Appendix F F 5.)

6. *Operating and care of locks and dams on Muskingum River, Ohio.*—As originally improved by the State of Ohio, 11 dams and 12 locks were built on the 91 miles of river from its mouth in the Ohio at Marietta to Dresden, where connection was made with the Ohio Canal, which carried the slack-water navigation to Lake Erie at Cleveland. The lock and dam above Zanesville is now in a state of ruin, but the 75 miles of slack water between Zanesville and the Ohio River has been maintained. The locks and dams on this part of the river passed into the hands of the United States in 1887. All the works were in bad repair and much reconstruction was unavoidable.

The amount expended up to the close of the fiscal year ending June 30, 1897, was $1,173,339.66, and all the locks and dams were put in fair order and were available for navigation.

The amount expended during the fiscal year ending June 30, 1898, was $41,323.92.

Lock No. 1 was closed fifteen days in September for repair and the river was closed by ice nine days. An unprecedented flood in March stopped navigation five days and did some damage to the works, which has since been repaired. Necessary repairs were also made to the locks, dams, buildings, and steamers—the plant in general—where needed.

The United States dredge and a towboat were usefully employed during the year in making and maintaining good navigable depth and width in the channels.

The total commerce transported on the river during the calendar year 1897 was 65,473 tons of freight, valued approximately at $3,224,933; passengers carried, 72,512. Whenever warranted all repair and reconstruction is done with a view to permanence, thereby reducing the cost of future maintenance to a minimum, but as many of the structures are old an exact statement can not be made in advance of the cost of keeping them in serviceable condition. Probably the yearly expense of operating and care of the locks and dams will not exceed 1 per cent of the value of the commerce transported.

(See Appendix F F 6.)

7. *Little Kanawha River, West Virginia.*—[This work was in the charge of Maj. James F. Gregory, Corps of Engineers, to July 31, 1897, and of Maj. William W. Harts, U. S. Volunteers, first lieutenant, Corps of Engineers, from July 31 to August 31, 1897.] There were four locks and dams in the stream, owned and controlled by the Little Kanawha Navigation Company, which afforded slack-water navigation from Parkersburg up to a point 2 miles above Burning Springs, W. Va., or a total distance upstream from Parkersburg of 40 miles. Above Burning Springs the river was much obstructed by logs, snags, bowlders, leaning trees, etc., rendering the floating of timber, the principal commodity, very hazardous.

The original project, adopted in 1877, provided for the removal of Beaver and Nailor Bend rocks, 53 and 54 miles, respectively, above Parkersburg, and for clearing the stream, above Burning Springs, of snags and overhanging and fallen trees.

There was added to the original project, by the act of Congress of June 14, 1880, provision for the construction of a lock and dam 2 miles above Burning Springs. The amount expended up to June 30, 1897, was $211,177.54. At that date the upper part of the stream had been placed in a fair condition for timber-floating purposes, so that, on moderate rises, light-draft steamboats could run as far as Grantsville, 78 miles above Parkersburg. The lock and dam, known as No. 5 of the system, and their appurtenances, 2 miles above Burning Springs, were completed and opened to navigation on December 2, 1891. This lock and dam and the four locks and dams owned by the navigation company afford 4 feet of slack-water navigation up to Creston, 50 miles above Parkersburg, when the supply of water in the stream is greater than the leakage through the dams of the navigation company, the condition of which is fully described in the Annual Report of the Chief of Engineers for 1895, Part III, pages 2520–2525.

In August, 1897, a small party was started at Dam No. 5 and worked upstream to Creston, W. Va., a distance of 8 miles, removing many troublesome obstructions. Owing to extreme low water, work was suspended on September 11.

The stream is the only means of transportation in the section of country through which it flows, and its commerce consists almost wholly of timber floated down from the upper portions, some of which is known to have been exported to Europe.

A statement of commerce is given under operating and care, etc., Little Kanawha River, West Virginia.

The maximum draft that can be carried over shoalest parts at present, is only about 2 feet at low water.

July 1, 1897, balance unexpended	$1,497.46
June 30, 1898, amount expended during fiscal year	694.15
July 1, 1898, balance unexpended	803.31

(See Appendix F F 7.)

8. Operating and care of lock and dam in Little Kanawha River, West Virginia.—[This work was in the charge of Maj. James F. Gregory, Corps of Engineers, to July 31, 1897, and of Maj. William W. Harts, U. S. Volunteers, first lieutenant, Corps of Engineers, from July 31 to August 31, 1897.] This lock and dam, known as No. 5 of the system, and located about 2 miles above Burning Springs, W. Va., or about 40 miles above Parkersburg, W. Va., was constructed under the additional project for improving Little Kanawha River, West Virginia, adopted in 1880. Lock No. 5 was opened to navigation on December 2, 1891, and has been in condition to be operated ever since that date, with the exception of a few days when it was closed for minor repairs. When the supply of water in the stream is more than the leakage through the four dams owned and operated by the Little Kanawha Navigation Company below No. 5, 4 feet of slack-water navigation is afforded in this stream from its mouth at Parkersburg, W. Va., up to Creston, W. Va., about 50 miles above Parkersburg.

The character of the four locks and dams controlled by the navigation company below No. 5 and their condition are described in the Annual Report of the Chief of Engineers for 1895, Part III, pages 2520–2525.

The amount expended up to June 30, 1897, was $17,298.57, in operating the lock and making minor repairs to the lock, dam, and appurtenances.

The amount expended during the fiscal year ending June 30, 1898, is $1,723.53. Repairs were made to the valve of lock. The dam was resheeted, filled, and backed in part, and its lower apron anchored. Some work was also done in improving the guide cribs of lock.

The commerce that has passed Lock No. 5 since it was opened to navigation, and which has consisted almost wholly of timber, has been as follows:

Fiscal year—	Tons.	Fiscal year—	Tons.
1890	140,115	1895	179,240
1891	190,688	1896	105,212
1892	244,254	1897	176,169
1893	137,072	Calendar year—	
1894	106,412	1897	127,943

(See Appendix F F 8.)

9. Great Kanawha River, West Virginia.—[This work was in the charge of Maj. James F. Gregory, Corps of Engineers, to July 31, 1897, and of Maj. William W. Harts, U. S. Volunteers, first lieutenant, Corps of Engineers, from July 31 to August 31, 1897.] This river flows through a region rich in mineral wealth, especially coal and salt. It was originally divided into a number of pools separated by shoals of gravel and coarse sand, which were the principal obstructions to navigation during the low-water period of each year, there being but a few inches of water on the shoal places at such times. Navigation was practically suspended in summer.

The original project, adopted in 1873, provided for removing large bowlders from the channel, excavating channels through the shoals, and constructing riprap dams and dikes, the object being to increase the depth of water on the shoal places so as to enable towboats to use the stream for a longer period each year than its natural condition permitted.

The modified project, adopted in 1875, provided for obtaining the depth of 6 feet of water all the year round throughout the whole river, 96 miles, by the construction of locks with movable dams from the mouth in the Ohio, at Point Pleasant, W. Va., up to Paint Creek, about 79 miles above Point Pleasant, and locks with fixed dams above Paint Creek, the declivity of the river above Paint Creek being too great to

permit of the advantageous use of movable dams. The original estimated cost of this improvement was placed at $4,153,000. This sum was somewhat reduced by reducing the total number of locks and dams from 12 to 11, one of the locks and dams originally estimated for in the lower portion of the river having been found, after more detailed examination, unnecessary. The original project also provided for three locks with fixed dams in the upper part of the river; only two of these have been constructed, Nos. 2 and 3, the construction of No. 1 having been dispensed with until its necessity became more apparent. By dropping these two locks and dams from the original project the original estimate was reduced by about $600,000. However, the revised estimate of 1892 (Annual Report, Chief of Engineers, 1892, pp. 2042–2044) showed that $1,305,700 still remained to be supplied by Congress in order to complete the project. This amount was appropriated by the acts of July 13, 1892, March 3, 1893, and March 2, 1895. The estimate of 1892 was made, however, before the exact site of Lock and Dam No. 11 had been selected, before a thorough knowledge of the amount of dredging between locks was had, and before the existence of the law limiting a day's work of a Government employee to eight hours. A revised estimate was therefore found necessary in 1896, and the amount of it, $273,000, was appropriated in the sundry civil act of June 4, 1897. It is thought the project may be completed without further appropriations.

Up to June 30, 1897, there was expended, under the original project of 1873, $50,000, and under the modified project of 1875, $3,604,520.75; a total of $3,654,520.75. The work accomplished resulted in removing the worst natural obstructions to navigation, the purchase of a towboat and a dredge, the dredging of channels at various points, the construction, complete, of Locks and Dams Nos. 2, 3, 4, 5, 6, 7, 8, 9, and 10, No. 11 being almost complete; also the construction of a telephone line connecting the office of the assistant engineer at Charleston, W. Va., with the different locks and dams.

List of dams.

No.	Distance above Point Pleasant.	Style of dam.	Completed in—	Remarks.
	Miles.			
2	84¼	Fixed	1887	In operation.
3	79¼	do	1882	Do.
4	73	Movable	1880	Do.
5	67¼	do	1880	Do.
6	54	do	1886	Do.
7	44	do	1893	Do.
8	36	do	1893	Do.
9	25¼	do	1898	Completed.
10	18¾	do	1898	Do.
11	1¾	do		Under construction.

During the fiscal year Locks and Dams Nos. 9 and 10 were practically completed, and No. 11 almost so. Considerable dredging was done, to the betterment of the channels.

The work done to June 30, 1898, has proved of much benefit to navigation, greatly increasing the commerce, although of late years there has been a falling off. Coal is the principal item carried, still there is considerable timber handled on this river. A statement of the commerce is given under operating and care, etc., Great Kanawha River.

The maximum draft that can be carried at mean low water over the shoalest part improved is about 6 feet to Dam No. 10. Below this point

it will be somewhat less until the Ohio River itself is locked and dammed below the mouth of the Kanawha.

July 1, 1897, balance unexpended		$553,679.25
June 30, 1898, amount expended during fiscal year		234,024.48
July 1, 1898, balance unexpended		319,654.77
July 1, 1898, outstanding liabilities	$7,529.51	
July 1, 1898, amount covered by uncompleted contracts	111,307.11	
		118,836.62
July 1, 1898, balance available		200,818.15

(See Appendix F F 9.)

10. Operating and keeping in repair the seven finished locks and dams in the Great Kanawha River, West Virginia.—[This work was in the charge of Maj. James F. Gregory, Corps of Engineers, to July 31, 1897, and of Maj. William W. Harts, U. S. Volunteers, first lieutenant, Corps of Engineers, from July 31, 1897, to August 31, 1897.] The two finished locks with fixed dams, known as Nos. 2 and 3, in the upper portion of the stream, and the five finished locks with movable dams, known as Nos. 4, 5, 6, 7, and 8, in the river below Nos. 2 and 3, were constructed under the appropriations for improving Great Kanawha River, West Virginia. The location, etc., of the seven finished locks and dams and of the three locks and dams to be known as Nos. 9, 10, and 11, now under construction under the appropriation for improving Great Kanawha River, West Virginia, is shown in the Annual Report of the Chief of Engineers for 1896, Part IV, page 2247.

The amount expended up to June 30, 1897, was $284,924.23, in operating and caring for the finished locks and dams, making renewals of those parts of the finished works which have deteriorated from use and exposure, and in dredging deposits from the lock chambers and entrances and some channels between locks originally formed by dredging under the appropriations for improving Great Kanawha River.

The amount expended during the fiscal year ending June 30, 1898, was $23,322.19. The finished locks and movable dams were operated through the year without interruption, excepting that due to ice and high and low water. Minor repairs were made as needed, and some riprapping done. Bars below the fixed dams were reduced to below minimum pool level. But little dredging has been necessary.

The commerce of the Great Kanawha River since 1889 has been as follows:

Fiscal year—	Tons.	Fiscal year—	Tons.
1890	1,127,232	1895	1,082,342
1891	1,225,355	1896	1,162,782
1892	1,360,750	1897	1,124,843
1893	1,116,537	Calendar year—	
1894	1,222,530	1897	832,002

There has been a large increase in the commerce of this river since the improvement, by the construction of locks and dams, was begun in 1875. The principal commodity has been coal, although a great deal of timber has also been handled. It is expected that the completion of Locks and Dams Nos. 9, 10, and 11 will cause still further increase of commerce.

(See Appendix F F 10.)

11. Elk River, West Virginia.—[This district was in the charge of Maj. James F. Gregory, Corps of Engineers, to July 31, 1897, and of Maj. William W. Harts, U. S. Volunteers, first lieutenant, Corps of Engineers, from July 31, 1897, to August 31, 1897.] The stream is one

of the chief tributaries of the Great Kanawha, emptying into it at Charleston, W. Va. Its course is tortuous, but the country through which it flows is rich in minerals and well fitted for agriculture and grazing. The stream was originally much obstructed by snags, rocks, overhanging trees, and was a succession of pools separated by rapids at shoals, over which latter, during dry seasons, there was but a few inches of water.

The project was adopted in 1878 (Annual Report, Chief of Engineers, 1876, Part II, pp. 166–176), and provided for improving the stream for bateau navigation by cutting sluices through the shoals. The estimated cost of this "open" navigation was placed at $100,000.

Up to June 30, 1897, $27,003.70 was expended, which resulted in the removal of snags, rocks, overhanging trees, the construction of cheap regulating dams to concentrate the water at some of the worst shallow places, and the making of narrow sluices through some of the rapids and shoals, so as to aid the transportation of country produce down stream in small boats and the return of the latter with merchandise, and also the floating of timber to market.

The only work done during the year was that authorized at Queen Shoal, 25 miles above Charleston, where some obstructions were removed and the dike raised from 3½ to 4 feet for 500 feet, putting the chute in good condition, at a cost of $105.93.

The maximum draft at mean low water on the 150 miles improved is about 2 feet.

The resumption of the work of actively removing the obstructions, with the appropriation of June 3, 1896, that have re-formed since the stream was last cleared up is held in abeyance pending the outcome of proceedings instituted by the United States attorney for the district of West Virginia for the purpose of securing the removal of the Frametown and Ashley dams, the principal obstructions now in the stream.

Commercial statistics.

Fiscal year—	Tons.	Fiscal year—	Tons.
1883	24,790	1892	139,800
1884	30,700	1893	125,400
1885	33,500	1894	92,630
1886	68,510	1895	112,100
1888	71,150	1896	92,000
1889	70,200	Calendar year—	
1890	89,880	1897	72,707
1891	103,700		

This commerce has consisted almost entirely of timber—logs, lumber, ties, and staves.

July 1, 1897, balance unexpended	$3,496.30
June 30, 1898, amount expended during fiscal year	108.73
July 1, 1898, balance unexpended	3,387.57
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	69,000.00

(See Appendix F F 11.)

12. Gauley River, West Virginia.—[This work was in the charge of Maj. James F. Gregory, Corps of Engineers, to July 31, 1897, and of Maj. William W. Harts, U. S. Volunteers, first lieutenant, Corps of Engineers, from July 31 to August 31, 1897.] The country at the head waters of this stream and its tributaries is covered with forests of the finest timber. For the first 12 miles from its mouth in the Great Kana-

wha River, or junction with New River, the Gauley falls only 4 feet per mile; in the next 26 miles its fall is nearly 34 feet per mile, in a gorge, the hills on either side being several hundred feet high and almost perpendicular, and the stream full of bowlders, some very large, and so numerous as to justify the name of "Roughs of Gauley" which has been given that section.

The project was adopted in 1888 (report of examination dated December 26, 1887, Annual Report, Chief of Engineers, 1888, Part III, pp. 1761–1767), and provided for 2-foot navigation for bateaux carrying 8 to 10 tons, and for rafts of logs, sawed stuff, railroad ties, etc., from the mouth of the river to the foot of the "Roughs," about 12 miles, and for improving the condition of the "Roughs" for about 28 miles farther, by blasting down the huge bowlders which formed such formidable obstructions.

The sum of $11,302.97 was expended up to June 30, 1897, principally below the "Roughs," in providing and maintaining 2-foot navigation for bateaux and for rafts, and in commencing work at the "Roughs."

On account of the short season for economical operations and the inexpediency of dividing work between two seasons, authority had been given to postpone the project for expending the appropriation of $3,000 made in 1896. Subsequently it was found that the conditions were so much altered by the building of railroads that further work under the approved project was inadvisable. In consequence nothing was done during the year. The commerce for the year consisted of 25,000 tons of lumber.

The funds can probably be profitably used in the upper river, but no recommendation can be made until the locality has been examined.

The maximum draft at mean low water for the first 10 miles is about 3 feet; above that point, less than 1 foot.

July 1, 1897, balance unexpended	$3,697.03
June 30, 1898, amount expended during fiscal year	34.45
July 1, 1898, balance unexpended	3,662.58
July 1, 1898, outstanding liabilities	4.50
July 1, 1898, balance available	3,658.08
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	60,000.00

(See Appendix F F 12.)

13. New River, Virginia and West Virginia.—[This work was in the charge of Maj. James F. Gregory, Corps of Engineers, to July 31, 1897, and of Maj. William W. Harts, U. S. Volunteers, first lieutenant, Corps of Engineers, from July 31 to August 31, 1897.] In its original condition the navigable channel consisted of natural chutes through the ledges and shoals. The chutes were of varying widths, and there was rarely over 1 foot of water at such points.

The original project was adopted in 1876 (report printed in the Annual Report of the Chief of Engineers for 1873, pp. 842–854), and provided for improving the stream from the lead mines in Wythe County, Va., to the mouth of Greenbrier River, West Virginia, by widening the channels from 30 to 50 feet, as might be required, deepening them to 2 feet, and straightening such as needed it for bateau navigation; the improvement, however, to be made in such manner as would aid the work should greater depth and width be required in the future.

The extension of the improvements from the lead mines in Wythe County, Va., up to the mouth of Wilson Creek, in Grayson County, Va., was provided for in the act of Congress of June 14, 1880. (Report on pp. 133-139, Part II, of the Annual Report of the Chief of Engineers for 1875, and report on pp. 538-545, Part I, of the Annual Report of the Chief of Engineers for 1879.)

The sum of $109,691.06 was expended up to June 30, 1897, for open-river navigation.

There were no expenditures during fiscal year ending June 30, 1898. The unexpended balance is, by the act of Congress of August 5, 1886, available for expenditure between the lead mines and Wilson Creek. As conditions have changed in late years, the further improvement of that portion of the stream has been reported as entirely unnecessary, and the Secretary of War has decided not to expend the existing balance at present.

July 1, 1897, balance unexpended	$2,308.94
July 1, 1898, balance unexpended	2,308.94

(See Appendix F F 13.)

14. Guyandotte River, West Virginia.—[This work was in the charge of Maj. James F. Gregory, Corps of Engineers, to July 31, 1897, and of Maj. William W. Harts, U. S. Volunteers, first lieutenant, Corps of Engineers, from July 31, 1897, to August 31, 1897.] The stream was practically closed before work was commenced. It was once improved by the State of Virginia by the construction of six timber locks and dams. These timber structures decayed, were abandoned, and became themselves obstructions to navigation. They were finally carried away from time to time by floods, and at the time the improvement was commenced by the United States the principal obstructions were snags, rocks, overhanging trees, and shoals.

The original project was adopted in 1878 (Annual Report, Chief of Engineers, 1875, Part I, pp. 747-755), and provided for removing such natural obstructions as snags, rocks, and overhanging trees, and concentrating and deepening the water over the shoals by low wing dams of loose stones, so as to aid light-draft steamboat navigation in the lower portion of the stream and the floating of timber down to the Ohio and thence to market.

Up to June 30, 1897, $21,418.79 had been expended, resulting in the partial improvement of the river for the distance of 119 miles up stream from its mouth, removing snags, logs, etc., cutting passageways through old dams, and constructing low dams of loose stones to deepen the water on shoals.

During fiscal year ending June 30, 1898, the expenditures were for maintaining the channel contemplated by the project.

The maximum draft that can be carried June 30, 1898, at mean low water, over the shoalest part of the locality under improvement, is about 20 inches.

Commercial statistics.

Fiscal year—	Tons.	Fiscal year—	Tons.
1891	61,128	1896	202,000
1892	103,800	1897	143,300
1893	182,250	Calendar year—	
1894	141,221	1897	190,000
1895	247,400		

This commerce consists almost entirely of timber, cross-ties, etc.

July 1, 1897, balance unexpended	$81.21
June 30, 1898, amount expended during fiscal year	42.75
July 1, 1898, balance unexpended	38.46
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	1,000.00

(See Appendix F F 14.)

15. Big Sandy River, West Virginia and Kentucky.—[This work was in the charge of Maj. James F. Gregory, Corps of Engineers, to July 31, 1897, and of Maj. William W. Harts, U. S. Volunteers, first lieutenant, Corps of Engineers, from July 31 to August 31, 1897.] In its original condition this river and its forks were much obstructed by rocks, bars, snags, and leaning trees. During the low-water period of each year navigation was practically suspended.

The original project, providing for the removal of rocks, snags, and overhanging trees from the main stream and the Levisa and Tug forks, which unite at the town of Louisa, Ky., to form the main stream, was for "improving Big Sandy River from Catlettsburg, Ky., to the head of navigation," and was adopted in 1878 (Annual Report, Chief of Engineers, 1875, pp. 756–769). This improvement was for the purpose of aiding light-draft steamboat, push-boat, and rafting navigation in the main river and the Tug and Levisa forks.

The project of 1878, for the improvement of the Big Sandy proper, was modified in 1880 so as to provide for the construction of a lock and fixed dam in that stream at Louisa, immediately below the junction of Levisa and Tug forks. In 1891, after the lock and a portion of the fixed dam at Louisa had been completed, the protests of those interested in the timber business against a fixed dam caused a Board of Officers of the Corps of Engineers to be convened to consider and report upon the subject of the dam, etc., and in its report, dated November 10, 1891 (Annual Report, Chief of Engineers, 1892, Part III, pp. 2101–2108), the Board recommended the substitution of a needle (movable) dam for the proposed fixed dam. This change of project was approved November 20, 1891.

The sum of $373,663.63 was expended to June 30, 1897, resulting, between 1878 and 1880, in improving low-water navigation by the removal of logs, stumps, snags, trees, and other obstructions from the bed of the river, as contemplated by the original project of 1878; the construction of a lock 185 feet long between hollow quoins and 52 feet wide and of a portion of the fixed dam, under the modified project of 1880; and in the reconstruction of the lock so as to conform to the requirements of the needle dam instead of a fixed dam, and in the construction of the dam, including navigation pass, pier, and weir, all in accordance with the modified project of 1891, providing for the construction of the movable dam instead of a fixed dam. The dam was operated for the first time on January 1, 1897.

During the fiscal year ending June 30, 1898, only work of a minor character was done—caring for Government grounds, protection work, etc. Some improvements were made to the dam, especially for operating same.

Commercial statistics.

Fiscal year—	Tons.	Fiscal year—	Tons.
1890	268,582	1895	545,910
1891	277,303	1896	471,382
1892	455,926	1897	414,500
1893	466,723	Calendar year—	
1894	297,800	1897	406,900

The above is the commerce of the three streams—Big Sandy proper, from Louisa, Ky., to its mouth in the Ohio at Catlettsburg, Ky., a distance of 26 miles, and of Levisa and Tug forks, which unite at Louisa to form the main river. This commerce consists of timber and farm products. The amount of commerce can not well increase until the main river below Louisa and Levisa and Tug forks above the limit of the slack water furnished by the needle dam completed at Louisa during the past year are improved by locks and dams, which form of improvement was favorably reported on in the Annual Report of the Chief of Engineers for 1889 (pp. 1990–1994). An estimate of cost and full special report thereon was submitted May 5, 1898, and is printed as House Doc. No. 456, Fifty-fifth Congress, second session. Also submitted herewith as Appendix F F 15.

The country bordering Levisa and Tug forks abounds in bituminous, cannel, and coking coal of good quality, but it remains undeveloped for lack of transportation facilities. All the appropriations made since 1880 for the main river have stipulated that the funds should be expended in constructing the lock and dam near Louisa, so that nothing has been done toward the removal of natural obstructions in the main river between the lock and Catlettsburg for about seventeen years. This portion of the river has become more or less obstructed in that time, and it is estimated that these obstructions may be cleared out at a cost of $2,000.

The maximum draft that can be carried over shoalest parts at present is only about 1 foot at low water.

July 1, 1897, balance unexpended	$6,336.37
June 30, 1898, amount expended during fiscal year	4,555.13
July 1, 1898, balance unexpended	1,781.24
July 1, 1898, outstanding liabilities	69.48
July 1, 1898, balance available	1,711.76
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	2,000.00

(See Appendix F F 15.)

16. Operating and care of lock and dam in Big Sandy River.—[This work was in the charge of Maj. James F. Gregory, Corps of Engineers, to July 31, 1897, and of Maj. William W. Harts, U. S. Volunteers, first lieutenant, Corps of Engineers, from July 31 to August 31, 1897.] This lock and dam, located near Louisa, Ky., was finished during the fiscal year of 1897, under the appropriation for improving Big Sandy River, West Virginia and Kentucky, the expenses for its operation and care since July 1, 1897, being paid from the indefinite appropriation provided by act of July 5, 1884. This is the only lock and dam in the Big Sandy River, and its effectiveness would be much increased by improving the forks above and the river below.

Beyond operating and care and making minor repairs and improvements nothing was done during the year. The dam proved very

satisfactory, maintaining a pool level during the dry season of 142 days. Its maneuvers were also successful, but some improvements in operating will be made.

The amount expended during the fiscal year ending June 30, 1898, is $1,936.54, used in the payment of salaries, etc.

The commercial statistics are given in the preceding item of improvement.

(See Appendix F F 16.)

17. Tug Fork of Big Sandy River, West Virginia and Kentucky.—[This work was in the charge of Maj. James F. Gregory, Corps of Engineers, to July 31, 1897, and of Maj. William W. Harts, U. S. Volunteers, first lieutenant, Corps of Engineers, from July 31 to August 31, 1897.] In its original condition this stream was much obstructed by rocks, snags, logs, and overhanging trees.

The project, adopted in 1880 (Annual Report, Chief of Engineers, 1875, pp. 756–769), provided for removing the natural obstructions in the stream and the construction of low wing dams of loose stones at shoal places, so as to aid the floating of timber and light-draft steamboat navigation.

The amount expended to June 30, 1897, was $27,011.25, resulting in the material improvement of navigation, giving increased facilities for push boats at low water, and rafting and light-draft steamboats at moderate stages, for the distance of 100 miles upstream from Louisa, Ky.

A small party was started in August, removing obstructions and rebuilding and repairing walls. Good progress was made.

The original project for improvement has been practically completed, but will require further attention each season to maintain the work in its present condition.

The maximum draft that can be carried June 30, 1898, at mean low water, over the shoalest part of the improvement is about 20 inches.

During the calendar year of 1897 there were carried 135,400 tons of timber, ties, etc., and 2,000 passengers.

The amount of commerce handled on the stream can not well increase until the latter is improved by locks and dams, which form of improvement was favorably reported in the Annual Report of the Chief of Engineers for 1889, pages 1990–1994, estimate of cost and full special report thereon having since been submitted under date of May 5, 1898, printed as House Doc. No. 456, Fifty-fifth Congress, second session. Also submitted herewith as Appendix F F 17. The country bordering on this stream abounds in coal of good quality, but it can not be marketed until means of cheap transportation are provided.

July 1, 1897, balance unexpended	$738.75
June 30, 1898, amount expended during fiscal year	722.64
July 1, 1898, balance unexpended	16.11
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	1,500.00

(See Appendix F F 17.)

18. Levisa Fork of Big Sandy River, Kentucky.—[This work was in the charge of Maj. James F. Gregory, Corps of Engineers, to July 31, 1897, and of Maj. William W. Harts, U. S. Volunteers, first lieutenant, Corps of Engineers, from July 31 to August 31, 1897.] In its original condition this stream was much obstructed by rocks, snags, logs, over-

hanging trees, and its pools were separated by rocky and sandy bars and shoals.

The project, adopted in 1880 (Annual Report, Chief of Engineers, 1875, pp. 756–769), provided for removing the natural obstructions in the stream and the construction of low wing dams of loose stones at shoal places, so as to deepen the water at those places for the purpose of aiding the floating of timber and light-draft steamboat navigation.

Up to June 30, 1897, $26,655.93 was expended in removing obstructions and constructing low, loose-stone dams, resulting in the material improvement of navigation, giving increased facilities for push boats at low water, and rafting and light-draft steamboats at moderate stages.

Dangerous obstructions were removed at Georges Creek during the year. A lack of funds prevented further work of improvement.

During the calendar year ending December 31, 1897, 220,800 tons of timber, ties, etc., and 10,000 passengers were carried.

No decided increase in the amount of commerce handled can take place until the stream is improved by locks and dams, which form of improvement was favorably reported on in the Annual Report of the Chief of Engineers for 1889, pages 1990–1994, and as to which an estimate of cost and full special report thereon has since been submitted under date of May 5, 1898, printed as House Doc. No. 456, Fifty-fifth Congress, second session. Also submitted herewith as Appendix F F 18. Canalization will provide cheap transportation for the almost unlimited quantities of coal which exist along the stream.

The maximum draft that can be carried June 30, 1898, at mean low water, over the shoalest part of the improvement is about 20 inches.

A dike in Levisa Fork, at or near the mouth of Georges Creek, is very much needed to prevent continued recurrence of accidents to steamboats and rafts.

July 1, 1897, balance unexpended	$94.07
June 30, 1898, amount expended during fiscal year	68.50
July 1, 1898, balance unexpended	25.57
Amount that can be profitably expended in fiscal year ending June 30, 1900, including maintenance. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	6,000.00

(See Appendix F F 18.)

SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896, AND RESOLUTION OF CONGRESS OF APRIL 14, 1898.

The surveys of the following localities, required by the river and harbor act of June 3, 1896, and resolution of Congress of April 14, 1898, were made by the local officer, Maj. W. H. Bixby, Corps of Engineers, and reports thereon submitted:

1. *Preliminary report of survey of Ohio River from Marietta, Ohio, to Pittsburg, Pa., with a view to improvement by movable dams to provide a depth of 6 feet at low water.*—Major Bixby submitted preliminary report of survey January 10, 1898. He states that the main work of the survey has been completed and that the information gained is being plotted, but while the office work will require several months, the data at hand are sufficient to indicate that such dams can advantageously be given a lift, or difference of level of adjacent pools, of from 6 to 8 feet, and a spacing of from about 4 to 15 miles; that the first dam (No. 7) will be located somewhere between Industry, Pa., and Georgetown, Pa.; that *the others*, Nos. 8, 9, 10, etc., will follow in regular order, commencing *below Babbs Island*, but their exact location can not now be determined;

that the total number of dams (including No. 7) will be between thirteen and eighteen, according to lift and spacing; that the cost of each will approximate closely those already constructed or under contract, viz, $750,000, including $25,000 for purchase of sites, and that their safe and proper completion will therefore require an appropriation of $750,000 (including $25,000 for purchase of sites) for Lock and Dam No. 7 above Georgetown, Pa., and a similar average amount for each of the others below Babbs Island, making the total estimate of cost between $9,750,000 and $13,500,000.

Full and detailed report of the results of this survey, with estimates for each dam, will be submitted when the field work is further plotted and the office work completed. The report was transmitted to Congress and printed in House Doc. No. 241, Fifty-fifth Congress, second session. (See also Appendix F F 19.)

2. *Plans and estimates of cost for improving Big Sandy River, including Tug and Louisa (Levisa) forks, West Virginia and Kentucky, by locks and dams.*— April 27, 1898, Major Bixby submitted report required by concurrent resolution of Congress passed by the House of Representatives April 13, 1898, and concurred in by the Senate April 14, 1898, authorizing and directing the Secretary of War—

to prepare and submit more complete plans and estimates for the improvement of the Big Sandy and the Tug and Louisa [Levisa] forks of same, in Kentucky and West Virginia, with probable cost of same; and also to submit to Congress information as to whether this proposed extended improvement should be made.

Major Bixby states that permanent and satisfactory improvement can be effected only by the construction of locks and movable dams, and in his opinion the natural wealth of this river basin, with its enormous coal deposits as yet undeveloped through lack of proper transportation facilities, will amply justify the thorough improvement of this river. He states that such thorough improvement, based on the experience already gained, will require the construction of 10 locks and dams on the Levisa Fork between Louisa and Pikeville, Ky.; 8 locks and dams on the Tug Fork between Louisa and the mouth of the Pond, and 3 locks and dams on the main river between Louisa and Catlettsburg, Ky., or 21 locks and dams in all, and the work already done upon the one dam now completed at Louisa indicates that the construction of such locks and dams will involve no special engineering difficulties if the funds be promptly provided therefor. He estimates the cost of these locks and dams, including embanking, retaining, riprapping, and paving of banks, purchase of sites, lock-employees' houses, storehouses and other buildings, dredging approaches to locks and passes, dredging shoals and removing obstructions between dams, etc., at an average of $225,000 each, or $4,725,000 in all.

Major Bixby's views regarding the rate at which appropriations should be made are given in his report, and if the improvement of these streams is to be undertaken, his remarks on this subject are worthy of the careful consideration of Congress. The report was transmitted to Congress and printed in House Doc. No. 456, Fifty-fifth Congress, second session. (See also Appendix F F 20.)

IMPROVEMENT OF MONONGAHELA AND ALLEGHENY RIVERS, WEST VIRGINIA AND PENNSYLVANIA.

This district was in the charge of Maj. Charles F. Powell, Corps of Engineers. Division Engineer, Col. Henry M. Robert, Corps of Engineers.

1. *Monongahela River, West Virginia.*—Several years ago the United States built Locks and Dams Nos. 8 and 9 on the Upper Monongahela

River, which extended an existing slack water upstream to next beyond Morgantown, W. Va., and made that place the head of packet navigation. Previously a downstream navigation of flats and small rafts at favorable river stages only was conducted. An inconsiderable amount of rafting continues above Morgantown. Before the improvement, and as now on the unimproved part, the river on low stages was easily forded at numerous shoals and rapids. Locks Nos. 8 and 9 are of sufficient capacity for the largest packets running on the river and afford minimum sill depths at pool levels of nearly 5½ feet.

The river and harbor act of 1896 provided for the extension of slack water by the construction of 6 locks and dams between Morgantown and Fairmont, W. Va., 25 miles upstream, the principal object being to afford water transportation for coal from river mines near Fairmont.

A contract for completion of the constructions within four years from date of notice that the United States had acquired title to necessary lands was approved December 9, and the contractor promptly commenced active operations at Lock No. 10 in the early spring, and by the end of the year the cofferdam inclosing the lock pit and space for guard cribs had been built, the excavation of the pit made, the cribs partly built, and considerable machinery and material delivered at the site. It is expected that the masonry at No. 10 will be completed this season; also that active operations will be begun at Lock and Dam No. 11. The locks and dams are to be built of concrete. The total lift, 64 feet, will back the water into the mouths of the forks of the river, a few miles above Fairmont.

The location of Lock and Dam No. 10 was changed from below the Morgantown Bridge to a site 3,000 feet above the bridge; the lands for Locks and Dams Nos. 10, 11, and 12 were purchased; options are held on the remaining sites; topographical surveys were made at all the sites, and about 700 borings made into the underlying rock at various proposed or selected sites to determine depth and character of foundations and fix exact locations of structures. The line of primary levels from Lock No. 9, upstream, was extended to the junction of the forks of the river and permanent bench marks were placed along the extension.

The amount expended upon the completed project, for surveys, examinations, and lands for extension of the project, to the close of the year ending June 30, 1897, is $442,688.95.

July 1, 1897, balance unexpended		$419,211.05
Amount appropriated by sundry civil act approved July 1, 1898		400,000.00
		819,211.05
June 30, 1898, amount expended during fiscal year		13,963.76
July 1, 1898, balance unexpended		805,247.29
July 1, 1898, outstanding liabilities	$4,663.48	
July 1, 1898, amount covered by uncompleted contracts	600,814.00	
		605,477.48
July 1, 1898, balance available		199,769 81
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		350,000.00

(See Appendix G G 1.)

2. Operating and care of locks and dams, Monongahela River.—Under authority of the river and harbor act of 1896 the United States acquired, by condemnation proceedings, near the beginning of the year the property and appurtenances of the Monongahela Navigation Company.

The amount of the award was $3,761,615.46. The property includes seven dams and sets of locks, which make slack water from near the mouth of the river at Pittsburg to Lock No. 8. Locks Nos. 1, 2, 3, and 4 are double locks, each set consisting of one large lock and one small lock; Locks Nos. 5, 6, and 7 are single and small locks. Controlling depths on the sills of the locks at pool levels vary from 4 feet to more than 8 feet. A history of the purchased slack-water system and an estimate of cost of its enlargement and improvement for affording adequate accommodation to a large and growing traffic are given in the last Annual Report, and may be found on pages 2412–2424 of the report of the Chief of Engineers for that year. The traffic of the river is restricted and hampered by insufficient capacity at the locks and in the channels.

The abolition of lock tolls has been followed by a marked increase of traffic, especially in packet and excursion business and transportation of coal for local consumption.

The freight traffic on the Lower Monongahela River is more than 6,000,000 tons.

Locks Nos. 8 and 9 were operated from the first of the year and Locks Nos. 1, 2, 3, 4, 5, 6, and 7 from July 7, except for short periods during floods, when navigation was suspended by ice, or when closed for necessary repairs, or during lowest stages in the case of two of the small locks where there are double locks on account of leakage. The aggregate number of lockages made at all the dams during the year was 80,885. Repairs to a considerable extent were made to keep the locks in serviceable condition; 368 snags and 19 wrecks were removed from the channels, and 117,900 cubic yards of material dredged from the lock entrances and pool channels.

The cost of operating and care of the locks and dams during the fiscal year was $128,813.17.

(See Appendix G G 2.)

3. *Allegheny River, Pennsylvania.*—In its original condition the Allegheny River, having a hard gravel and sand bottom, with an average slope for a distance of more than 123 miles between its mouth and French Creek at Franklin, Pa., of 2.15 feet per mile and of 3.4 feet per mile over 132 miles between Franklin and Olean, N. Y., was obstructed by numerous large bowlders, which reduced the low-water navigable depth as much as 2 feet on various ripples and made navigation over them extremely hazardous at ordinary stages. The river also embraced several wide-spreading shoals, giving an available navigable depth at low water of less than 6 inches. The originally adopted plan of improvement of the river, which has not been materially changed since its inception, contemplates the removal of bowlders, snags, and other obstructions from the channel and the construction of low dams to close duplicate channels and of dikes to confine the water way on extensive shoals. There had been expended under this project from the date of the first appropriation, in 1879, up to the close of the fiscal year ending June 30, 1897, the sum of $218,233.87, about two-thirds of which had been devoted to the removal of new rock obstruction washed out from the banks, brought down by the rapid tributaries, or moved along the river bed by the action of freshets and ice. The latter is a powerful agent in modifying the river bed. The result has been a marked improvement, furnishing a least depth of 1.4 feet over the shallowest bars at low water, with ample width of channel and a consequent lengthening of the period of navigation, enabling the lighter craft to enjoy practically continuous navigation over 150 miles of the stream.

During the year the Red Bank Dike was extended 1,000 feet. Two thousand nine hundred and ninety-nine cubic yards of bowlders and 45 snags were removed from the channel. The removed bowlders were generally conveyed to the bank for its protection or placed in side channels to prevent waste of water through them. The abutment of the dam at Tionesta and the head of the upper dike at Cowanshannock were repaired, and the channel face of Hickory Island, which had been badly scoured and threatened to spoil an improved channel, was protected.

July 1, 1897, balance unexpended	$11,766.13
June 30, 1898, amount expended during fiscal year	11,186.00
July 1, 1898, balance unexpended	580.13
July 1, 1898, outstanding liabilities	3.20
July 1, 1898, balance available	576.93
Amount that can be profitably expended in fiscal year ending June 30, 1900. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	15,000.00

(See Appendix G G 3.)

4. Construction of locks and dams at Herr Island, above the head of Six-mile Island, and at Springdale, Allegheny River.—The originally adopted project provided for the Herr Island Lock and Dam and contemplated that the dam should be a fixed one; but in compliance with a request of the authorities of Pittsburg and Allegheny the plan was changed to give a movable dam, and to satisfy riparian owners the site of the lock was changed so that a waterway for landings 55 feet in width is left between the lock and the river bank. The site of the Herr Island works is in Pittsburg Harbor, formed by the pool of the Davis Island Dam of the Ohio River 6.3 miles below, which gives a navigable depth in the Allegheny River channel of 8 to 9 feet as far as Garrison Ripple, immediately above the Herr Island Dam and about 2 miles above the mouth of the river. The completion of the original project will extend Pittsburg Harbor 4.5 miles farther upstream and begin a system of slack water upon the Allegheny River.

The river and harbor act of 1896 provided for the construction of two additional locks and dams, which will extend slack water having 6 feet least channel depth from the Herr Island pool 17 miles, or to Natrona. The additional works are under contract.

During the year the masonry of the Herr Island Lock was completed, chamber floor and aprons under emptying culverts laid, and the fixed dam and bulkhead masonry wall along the harbor line in front of public property built. It is expected to build at least one-half of the movable dam before the fall freshets occur and erect lock gates and place lock machinery by the time of the completion of the dam.

The selected lock land at Six-mile Island is a narrow strip of unimproved river bank belonging to the city of Pittsburg, whose officials insist upon a purchase price of about $15,000.

Agreement had been made for the purchase of the lock land at Springdale, but difficulty occurring in obtaining satisfactory title on account of liens, whose release could not be obtained, condemnation proceedings were instituted, and concluded late last winter. As soon thereafter as river conditions reasonably permitted, the contractor shipped machinery and materials to the site, and on May 25 commenced active work. By the end of June the lock pit was partly excavated and a cofferdam nearly finished, a railroad side track, cement house, and other tempo-

rary structures erected, guide piles for building dam driven, and its trench partly dredged.

The amount expended upon the whole project to the close of the fiscal year ending June 30, 1897, is $221,985.98.

July 1, 1897, balance unexpended		$365,514.02
Amount appropriated by sundry civil act approved July 1, 1898		300,000.00
		665,514.02
June 30, 1898, amount expended during fiscal year		49,227.99
July 1, 1898, balance unexpended		616,286.03
July 1, 1898, outstanding liabilities	$15,130.95	
July 1, 1898, amount covered by uncompleted contracts	396,424.70	
		411,555.65
July 1, 1898, balance available		204,730.38
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		244,000.00

(See Appendix G G 4.)

SURVEY MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The survey for *removal of dam in Upper Allegheny River near Corydon, Pa., and of all the dams on the Conewango Creek, and the rapids at or near Waterboro, in the Conewango Creek*, was made by Maj. Chas. F. Powell, Corps of Engineers, and report submitted November 13, 1897.

Corydon Dam.—Major Powell states that since the construction by the Government in 1888 of crib work along the lower slope of this structure there has been no special trouble experienced by raftsmen in running the dam; but below the dam there is a gravel bar extending more than half way across the chute, which makes the channel tortuous and inconvenient for rafts, and that it is expected to make a needful excavation here next year should the appropriation for improving the river be sufficient to permit work so far upstream. The cost of removing the dam to a depth of 4 feet from low-water level below the dam is estimated at $897.50.

Dams on the Conewango Creek.—The cost of removing all these dams (four in number) is estimated at $2,400, exclusive of damages for destroying or diminishing water powers.

Waterboro Rapids.—It is stated in the report that there is no navigation on Conewango Creek other than some little logging, and that none other is in prospect. The cost of making a cut-off from the head of these rapids is estimated at $11,500, exclusive of costs for land and drainage; of removing the upper part of the rapids by excavation from their head along the creek to the pool of the Kennedy Dam, $22,500, and of removing the whole of the rapids by similar excavation, $90,000, exclusive of damages to the Kennedy water power. The effect of either of such works would be to lower the water levels above the rapids and raise them below the end of the cut-off or excavations, and generally to disturb the present small conservation of the flow of the creek.

In the opinion of Major Powell, the removal of the Corydon Dam at the present time and of the dams or of the rapids at or near Waterboro, in Conewango Creek, is a work not worthy nor justified by the interests of commerce involved.

The report was transmitted to Congress and printed in House Doc.

No. 110, Fifty-fifth Congress, second session. (See also Appendix G G 5.)

Major Powell was also charged with the duty of making surveys of the following localities, reports of the results of which will be duly submitted when received:

1. *Allegheny River, Pennsylvania, for extending navigation by locks and dams.*

2. *West Fork River, West Virginia.*

LAKE RIVERS AND HARBORS.

IMPROVEMENT OF RIVERS AND HARBORS ON LAKE SUPERIOR.

This district was in the charge of Maj. Clinton B. Sears, Corps of Engineers. Division Engineer, Col. J. W. Barlow, Corps of Engineers.

1. *Harbor at Grand Marais, Minn.*—This small natural basin was not originally of sufficient depth, nor was it adequately sheltered, either for commercial purposes or for use as a harbor of refuge. The approved project of 1879 proposed two breakwater piers, each 350 feet long, from the east and west points of the bay, or one pier 700 feet long from the east point, and the dredging to a depth to accommodate the prevailing draft of vessels, which was 14 feet. The original estimated cost was $139,669.40, but for reasons explained in the report of the local officer (Appendix H H 1), this is now increased to $163,954.63. Up to the close of the fiscal year ending June 30, 1897, there had been expended on this work $132,621.77. With this sum 350 feet of the east pier has been completed and the 16-foot anchorage area increased to 26 acres. The increment of commerce which has accrued since the improvement of this harbor began bears the ratio of 25 entrances and clearances (made by four tugs and five schooners), with 60 tons of cargo, valued at $6,000, in 1878, to 371 entrances and clearances (nearly all steamers), with 1,777 tons of cargo, valued at $122,868, in 1897. The improvement has cost $132,745.37. The value of the commerce of the harbor from 1878 to 1897, both inclusive, is roughly estimated at $911,369. The unexpended balance of the last appropriation will be reserved as a repair fund in case of accidents until another appropriation becomes available.

July 1, 1897, balance unexpended	$728.23
June 30, 1898, amount expended during fiscal year	123.60
July 1, 1898, balance unexpended	604.63

Amount (estimated) required for completion of existing project	30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H H 1.)

2. *Harbor at Agate Bay, Minnesota.*—This harbor, 27 miles east of Duluth, is a shipping port for iron ore and is a harbor of refuge.

The project for the improvement was adopted in 1887 and contemplates the erection of two piers projecting from the headlands of the bay and inclosing about 109 acres of water area, natural depth of 20 feet or more. The eastern pier is to be 1,000 feet long and the western one 900 feet. Work upon the east pier was commenced in 1887, and at the close of work in November, 1897, besides the 750 feet of east pier built in 1891 there were completed 550 feet of west pier and 410 feet of rock embankment brought to the 20-foot level for the foundation of

the extension to said pier. A contract for 300 feet of this extension is now in execution and will be completed by November, 1898. The amount expended to June 30, 1897, was $120,999.70.

The commerce of this harbor has increased from 236,000 cargo tons, valued at $524,800, in 1885, to 2,730,322 cargo tons, valued at $4,000,000, in 1897. The total valuation of the commerce of this port for twelve years, 1885 to 1897, is roughly estimated at $24,500,000.

The arrivals and departures of vessels have increased from 174, with a registered tonnage of 295,800 tons, in 1885, to 2,064, with a registered tonnage of 6,192,000 tons, in 1897.

July 1, 1897, balance unexpended	$51,500.30
June 30, 1898, amount expended during fiscal year	34,389.84
July 1, 1898, balance unexpended	17,110.46
July 1, 1898, amount covered by uncompleted contracts	15,300.00
July 1, 1898, balance available	1,810.46
Amount (estimated) required for completion of existing project	71,708.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix H H 2.)

3. Harbor at Duluth, Minn., and Superior, Wis.—Previous to the Annual Report of 1897 this harbor was reported on under the separate heads of Duluth, Minn., and Superior, Wis., respectively.

The act of June 3, 1896, unified these harbors under the above title and provided for continuous contracts for its improvement to the amount of $3,080,553.

This harbor now consists of the Duluth Canal, the Wisconsin Entrance, Superior Bay, Allouez Bay, St. Louis Bay, and St. Louis River to the limits of the cities of Duluth and Superior, about 20 miles from the original natural entry, which, before improvement, was obstructed by shifting bars, with but 9 feet of water over them. The bays were broad expanses of shallow water, averaging only 8 or 9 feet, except along the channel through them, where the depth was greater but variable.

The project previous to the present one was for 16-foot navigation. This was practically completed July 1, 1897, and resulted in giving a good 16-foot navigation through the natural or Wisconsin entry; through the artificial Duluth Canal; over the Duluth Basin, of 104 acres; along and parallel to the dock lines of Duluth and Superior, in Superior and St. Louis bays, and up the St. Louis River to New Duluth, near the head of navigation of the river, with well-defined channels from 85 to 300 feet in width.

The amount expended thereupon up to the close of the fiscal year ending June 30, 1897, was $1,587,526.97. The improvement thus made is in excellent condition, and the expenditure has been amply justified by the immense commerce which it has readily accommodated.

The present project, authorized by the act of June 3, 1896, provides for the widening and deepening to 20 feet of existing channels; for a new 20-foot channel along Minnesota Point dock line; for new channels in Allouez Bay; for extensive turning and anchorage basins 20 feet deep at the junction of two or more channels; for widening the Duluth Canal, and for replacing with substantial structures of timber and monolithic concrete the piers at the Duluth Canal and the Wisconsin Entrance.

The contracts for dredging are now well under way, eleven dredges being at work, and up to June 30, 1898, 2,637,284 cubic yards had been excavated.

All the land necessary for the widening of the Duluth Canal has at last been been acquired by deed of gift, purchase, or condemnation, at a cost of $52,619.05. A contract for building the substructure of the new south pier has been made with King & Steele, of Duluth, and also with the same firm a contract for the construction of 686 concrete footing blocks, as foundation for the monolithic concrete superstructure. Both these works are now under way. Contracts have also been made and partially completed for strengthening the Wisconsin Entrance piers with timber facing and stone riprap, preparatory to capping them with monolithic concrete superstructures.

The sundry civil act of July 1, 1898, appropriated $770,138 for this harbor, making a total of $1,207,638 so far appropriated out of the $3,080,553 authorized for the continuous contracts. The contracts yet to be made are for the substructure for the north pier, Duluth Canal; for the superstructure for both piers, and for the superstructure of the piers at the Wisconsin Entrance. A small portion of the appropriation will also be used for the purchase by condemnation of the necessary land on the south side of the Wisconsin Entrance.

The lake commerce of this port—Duluth and Superior—during the last season of navigation amounted to over $118,500,000, as a very conservative valuation, and since the United States took charge of this harbor this commerce has amounted to over $1,018,500,000.

July 1, 1897, balance unexpended		$448,156.03
Amount appropriated by sundry civil act approved July 1, 1898		770,138.00
		1,218,294.03
June 30, 1898, amount expended during fiscal year		289,228.62
July 1, 1898, balance unexpended		929,065.41
July 1, 1898, outstanding liabilities	$18,384.66	
July 1, 1898, amount covered by uncompleted contracts	2,060,147.99	
		2,078,532.65
Amount (estimated) required for completion of existing project		1,872,915.00
Amount that can be profitably expended in fiscal year ending June 30, 1900		300,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix H H 3.)

4. Harbor at Ashland, Wis.—Ashland Harbor is located at the head of Chequamegon Bay, and originally had no protection from the waves which rolled into the bay nor from the waves generated within the bay itself by storms.

The approved project is for the construction of a pile, slab, and rock breakwater 8,000 feet long and for dredging a channel along the shoal portion in front of the wharves of the city.

Seven thousand three hundred and sixty-three linear feet of the breakwater was completed in 1893, since which time no work of extension has been undertaken, subsequent appropriations having been used in strengthening and maintaining the old work and in dredging.

The act of June 3, 1896, appropriated $27,000 for this harbor, and of this $9,000 was expended in strengthening the older portion of the work by filling in between the piles with large rock, and of the balance $13,260 was expended in dredging a channel parallel with and about 150 feet from the harbor line, which had been established at the request of the city council.

The total amount expended under approved project and in repairs to June 30, 1897, was $220,847.98.

The breakwater has a marked influence in improving the tranquility of the harbor. The work done during the fiscal year ending June 30, 1898, has resulted in materially strengthening the older portions of the breakwater and in starting a channel along the shoaler part of the harbor-line front. Available depth of water, 18 feet.

The commerce of this port consists principally of iron ore and lumber exported, and coal, mineral oil, and general merchandise imported. The commerce has largely increased during the twelve years the harbor has been under improvement by the United States, the total commerce having a valuation, roughly estimated, of $325,000,000.

July 1, 1897, balance unexpended	$18,652.02
June 30, 1898, amount expended during fiscal year	16,656.00
July 1, 1898, balance unexpended	1,996.02

Amount (estimated) required for completion of existing project	346,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H H 4.)

5. *Harbor at Ontonagon, Mich.*—The entrance to Ontonagon River, which forms the harbor, had but 7 feet depth in 1867, at which time the project for securing 12 feet depth by building parallel piers on either side of the mouth, extending to the 18-foot curve of depth in Lake Superior, and dredging a channel between the piers, was adopted. The west pier was built to a length of 2,675 feet and the east pier to a length of 2,315 feet. This brought the outer end of the west pier very nearly to the 18-foot curve of depth, as proposed. But this curve has advanced since, owing to the very considerable volume of sand carried into the lake by the river, and as it appears probable that the advance of the bar will keep pace with the extension of the piers unless a very considerable extension is made at once, it does not appear that economic considerations would justify any further extension of the piers. It seems that better results will be secured by keeping the piers in repair and by dredging across the bar after each spring freshet.

As far as new work is concerned the project may be said to be completed, and further expenditure will be needed only for keeping a 12-foot channel open by dredging and for the repairs to the piers.

The balance of the $10,000 appropriated by the act of June 3, 1896, is being held for emergencies, such as accidents to the piers by storms, ice, etc., requiring renewals, and for dredging as soon as the ruling depth of 12 feet between the piers becomes materially impaired.

The total cost of the improvement to June 30, 1897, was $335,448.64. This has resulted in keeping open a good navigable 12-foot channel. Of late years the annual commerce has been roughly estimated at $1,000,000. The great fire, however, destroyed the principal commercial industry—the plant of the Diamond Match Company, and this company has not rebuilt. No appropriation is recommended for the next fiscal year.

July 1, 1897, balance unexpended	$9,679.36
June 30, 1898, amount expended during fiscal year	756.25
July 1, 1898, balance unexpended	8,923.11

(See Appendix H H 5.)

6. Waterway across Keweenaw Point from Keweenaw Bay to Lake Superior, Michigan.—This work was formerly reported on as the Portage Lake and Lake Superior canals, across Keweenaw Point, Michigan.

In accordance with the provisions of the river and harbor act of September 19, 1890, the United States purchased and assumed the charge and care of these canals on August 3, 1891.

At the time of purchase by the United States there was a very poor 13-foot navigation; the channel was narrow and crooked, with many sharp bends; it was poorly marked and lighted; the entrance piers were in a very bad condition; the revetments were rotten or entirely gone, and there was a tax on the commerce through the canals in the shape of a tonnage charge.

The improvements consist of entrance piers at the harbor entrances on Lake Superior and Keweenaw Bay, canals and canal revetments, and dredged cuts and channel ways. There are no locks.

The approved project is for a 20-foot channel 120 feet wide, a renewal of the canal revetments, a reconstruction of the piers at the upper and lower entrances, and their extension to 30 and 20 feet of water, respectively.

The act of June 3, 1896, authorized continuing contracts to complete the above to the amount of $1,065,000.

The sundry civil act of June 4, 1897, appropriated $350,000, and that of July 1, 1898, $450,000, making a total of $800,000 for the execution of these contracts, three of which are now under way, viz: One for 2,800 feet of pier extension at the Keweenaw entrance, to cost $120,000; one for 5,480 feet of breakwater piers at the upper entrance, to cost $300,000, and one for dredging 950,000 cubic yards of material, at a total cost of $80,000. Of the total appropriation, therefore, $500,000 is pledged. The contracts yet to be made are for widening the upper canal about 50 feet and deepening to 20 feet; for widening and deepening the other channels to give a 20-foot navigation, and the revetments of the banks of all the artificial channels. The available depth is 16 feet.

During the past season of navigation, that of 1897, the commerce through this waterway has amounted to 920,546 tons of commodities, having an estimated value of $34,000,000, and 34,936 passengers, being an increase over the traffic of 1896 of 1,622 tons, $5,000,000 in value, and a decrease of 6,326 passengers, respectively.

During the fiscal year ending June 30, 1898, $39,742.22 has been expended in dredging and $9,676.10 in pier work and incidentals.

The money now appropriated will be sufficient to carry on work until the close of the fiscal year ending June 30, 1900, so that no appropriation is asked for in the next sundry civil bill.

Total amount expended on this work to June 30, 1897, $189,834.04.

July 1, 1897, balance unexpended	$390,165.96
Amount appropriated by sundry civil act approved July 1, 1898	450,000.00
	840,165.96
June 30, 1898, amount expended during fiscal year	49,418.32
July 1, 1898, balance unexpended	790,747.64
July 1, 1898, amount covered by uncompleted contracts	490,000.00
July 1, 1898, balance available	300,747.64
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	265,000.00

(See Appendix H H 6.)

7. Operating and care of waterway across Keweenaw Point from Keweenaw Bay to Lake Superior, Michigan.—The expenses of operating and care of this waterway for the fiscal year ending June 30, 1892, during which it was acquired by the United States, were paid by an appropriation of $10,000 made for the purpose by act of September 19, 1890.

During the fiscal year ending June 30, 1898, $8,300 from the permanent-indefinite appropriation of July 5, 1884, was expended in maintaining, by dredging, a practicable 16-foot stage of water, in superintendence and general operation of the canals, and in guarding against encroachments on the legally established harbor lines.

(See Appendix H H 6.)

8. Harbor at Marquette, Mich.—Originally this harbor afforded no protection to vessels from easterly or northeasterly storms, and projects were approved for the construction of a breakwater composed of cribs filled with rock and projecting from the shore into the bay a distance of 3,000 feet. This breakwater was finished in 1894, practically as projected, but since its commencement extensive repairs have been made to the superstructure. The harbor has natural deep water of 18 feet or more.

A project for a concrete superstructure was approved in February, 1890. Its estimated cost was $232,936.71.

Work on this concrete superstructure was begun in the spring of 1895, and up to June 30, 1897, 860 linear feet had been completed.

During the past fiscal year 140 linear feet of the main superstructure has been built, making the total length of completed work 1,000 linear feet.

In this latitude the working season is very short, especially for concrete made in place. For this reason it will be decidedly economical to have sufficient funds in hand at one time to utilize the whole of two consecutive seasons.

The breakwater has given complete protection to the harbor, and commerce has grown steadily until it amounts now to some $2,500,000 annually. The permanent maintenance of the breakwater by a durable concrete superstructure will do away with the frequent and expensive repairs incident to timber work.

The total cost of the work to June 30, 1897, was $525,362.41.

July 1, 1897, balance unexpended	$8,195.35
June 30, 1898, amount expended during fiscal year	6,180.96
July 1, 1898, balance unexpended	2,014.39

Amount (estimated) required for completion of existing project	198,936.71
Amount that can be profitably expended in fiscal year ending June 30, 1900	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix H H 7.)

9. Harbor of refuge, Marquette Bay, Michigan.—This is a work authorized by the act of June 3, 1896. Marquette Bay is a small bay within the city limits of Marquette, north of Marquette proper, and distant 1½ miles therefrom.

A resolution of Congress approved March 20, 1896, directed the Secretary of War to make a survey and submit an estimate for a breakwater in this bay. The results of this survey, with estimates amounting to $20,000 for breakwater 500 feet long and $50,000 for construction of one 1,000 feet long, were published in House Doc. No. 318, Fifty-fourth Congress, first session.

By the act of June 3, 1896, $20,000 was appropriated for the improvement of this harbor.

The approved project is to build a breakwater 1,000 feet in length off Presque Ile Point. Of this 500 linear feet was completed last fall, and also an extra crib extension toward shore, 50 feet long.

Total expended to June 30, 1897, $855.95.

July 1, 1897, balance unexpended	$19,144.05
June 30, 1898, amount expended during fiscal year	18,123.37
July 1, 1898, balance unexpended	1,020.68

Amount (estimated) required for completion of existing project	30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H H 8.)

10. Harbor of refuge at Grand Marais, Mich.—Originally the entrance to this harbor was obstructed by a bar having but 9 feet depth of water upon it. The project for its improvement, adopted in 1881, has for its object a deep and safe channel into the harbor, making it a harbor of refuge. This object is to be attained by building parallel piers projecting into the lake and dredging out a channel between them, connecting the deep water of the lake with that of the harbor, and by closing up the natural entrance, 5,700 feet in width, by a solid pile dike, driven with a slope toward the waves and strongly braced. The proposed length of each pier was 1,800 feet. The west pier has now reached a length of 1,656 feet and the east pier 1,153 feet.

An examination made in June, 1898, showed a least depth of 13½ feet along the channel between the piers, but at the entrance this channel has a deviation to the east, owing to the encroachment of a bar making across the entrance from the west.

The pile dike was successfully finished August 5, 1897, by hired labor and plant owned by the United States, and, barring a few breaks which have been promptly repaired at small expense, it has successfully withstood the fall and spring storms and the action of the ice during the winter. It is continually gaining in strength, due to the accumulation of sand against it. The 250 feet of extension to the west pier was practically completed June 30, 1898.

The total amount expended to June 30, 1897, was $285,750.83. The amount expended during the year ending June 30, 1898, was $13,446.56. The result has been the creation of a very safe and commodious harbor of refuge for vessels drawing 13 feet. It is expected that the completion of the project will make this safely accessible for vessels of 16 feet draft.

July 1, 1897, balance unexpended		$19,499.17
June 30, 1898, amount expended during fiscal year		13,446.56
July 1, 1898, balance unexpended		6,052.61
July 1, 1898, outstanding liabilities	$898.80	
July 1, 1898, amount covered by uncompleted contracts	4,998.00	
		5,896.80
July 1, 1898, balance available		155.81

Amount (estimated) required for completion of existing project	178,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix H H 9.)

11. Removing sunken vessels or craft obstructing or endangering navigation.—The wreck of the steamer *Winnipeg* being a menace to the navigation of Duluth Harbor, Minnesota, its removal under the provisions of the act of June 14, 1880, was authorized, and, after advertisement, contract for the work was entered into, operations under the same being in progress at the close of the year. The amount expended during the year on removal of wrecks is $300.

(See Appendix H H 10.)

IMPROVEMENT OF RIVERS AND HARBORS ON WESTERN SHORE OF LAKE MICHIGAN.

This district was in the charge of Capt. George A. Zinn, Corps of Engineers. Division Engineer, Col. J. W. Barlow, Corps of Engineers.

1. Menominee Harbor, Michigan and Wisconsin.—The survey made in 1871 with a view to the improvement of the entrance to the Menominee River showed that it had a depth of 5 feet. The project for its improvement, adopted in 1871 and modified in 1874, provided for construction of two parallel piers 400 feet apart and for dredging between them, the object being to secure a channel of navigable width not less than 15 feet deep. In 1890 this was modified to secure a depth of 17 feet.

The amount expended up to June 30, 1897, was $225,314.48.

The original and modified projects have been completed, and except in places the full depth of 17 feet below the datum plane has been secured.

The dredging and repairs in progress June 30, 1898, are for restoration and maintenance of channel and piers.

The maximum draft that can be carried June 30, 1898, is 16.5 feet.

Commercial statistics for 1897.—Arrivals of vessels, 798; tonnage, 227,696. Total approximate value of imports by way of harbor, $200,000; exports, $5,000,000.

Amount estimated for fiscal year ending June 30, 1900, for maintenance is $5,500.

July 1, 1897, balance unexpended	$3,897.52
June 30, 1898, amount expended during fiscal year	1,854.93
July 1, 1898, balance unexpended	2,042.59
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	5,500.00

(See Appendix I I 1.)

2. Menominee River, Michigan and Wisconsin.—The survey made in 1889, with a view to the improvement of the Menominee River, showed a governing depth of about 5 feet, and that by private enterprise a tortuous channel had been dredged about 50 feet wide and 14 feet deep, extending up the river a distance of 2 miles.

The original project of 1890 provided for the expenditure of $54,000 for dredging a channel 200 feet wide and 17 feet deep from Green Bay up the Menominee River as far as available funds would admit.

In 1892 additional funds were appropriated, and the project provided for making the 200-foot channel about 9,000 feet long, and thence for a distance of 2,600 feet reducing its width to 100 feet. The act approved June 3, 1896, appropriated $15,000 and provided for the formation of a

turning basin 600 feet long and 250 feet wide; also for extending the channel 425 feet, with a width of 75 feet. The total amount expended to June 30, 1897, was $84,456.17. This expenditure resulted in completing the original project, the modification of 1892, and the turning basin provided for in the project of 1896, a depth of 17 feet below the datum plane being secured.

Dredging done during the fiscal year ending June 30, 1898, completed the project of 1896. In January, 1898, the governing depth in the channel was 16½ feet.

The maximum draft that can be carried June 30, 1898, is 16 feet.

The commercial statistics for Menominee River are the same as for Menominee Harbor. (See Menominee Harbor report.)

Amount estimated for fiscal year ending June 30, 1900, for maintenance is $7,500.

July 1, 1897, balance unexpended	$11,123.86
June 30, 1898, amount expended during fiscal year	10,971.68
July 1, 1898, balance unexpended	152.18
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	7,500.00

(See Appendix I I 2.)

3. Oconto Harbor, Wisconsin.—In its natural condition the channel at the entrance to the Oconto River was obstructed by a bar with less than 3 feet of water over it. Previous to 1881, when the first appropriation was made for its improvement, the citizens, by the construction of a small amount of slab pier and by dredging, had increased the depth to 4½ feet.

The part of the river between the mouth and the city of Oconto had a width of from 150 to 250 feet and a low-water channel depth of from 4 to 6 feet.

The project of improvement, adopted in 1882, proposed to secure a 9-foot channel from Green Bay to the city of Oconto, a distance of 2 miles, by dredging and constructing piers, at an estimated cost of $150,000.

A modification adopted in 1897 provided for making Spies's mill the terminus of the improved channel, thereby abandoning 3,800 linear feet of the originally projected improvement.

The total amount expended up to June 30, 1897, was $77,845.12.

At that date the south pier was of its projected length, and to complete the north pier to its full length an extension of 875 feet was required. The channel had a depth of 9 feet for a width of 70 feet.

There have been no operations during the fiscal year ending June 30, 1898, on which date the channel had a depth of 8.5 feet, and the maximum draft that can be carried within 600 feet of Spies's mill is 8.5 feet.

Commercial statistics for 1897.—Arrivals of vessels, 630; tonnage, 36,550. Exports, lumber and saw logs, 35,250 tons; imports, stone, 49,000 tons.

It is estimated that $25,000 will be required for improvement of the harbor and for maintenance during the fiscal year ending June 30, 1900.

July 1, 1897, balance unexpended	$154.88
July 30, 1898, amount expended during fiscal year	122.33
July 1, 1898, balance unexpended	32.55
Amount (estimated) required for completion of existing project	37,610.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, including maintenance	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix I I 3.)

4. *Pensaukee Harbor, Wisconsin.*—The original depth of water at the mouth of Pensaukee River was 2 feet, increased by private enterprise to from 8 to 10 feet for a width of 30 feet.

The project for the improvement of this harbor was adopted in 1883, and consisted of the construction of a single slab pier 2,500 feet long, in continuation of the pier built by private enterprise, and dredging a channel 11 feet deep and 100 feet wide on the south side of the pier.

The total amount expended up to June 30, 1898, was $15,000, up to which date the slab pier had been extended 1,300 feet and a channel 11 feet deep and 25 feet wide had been dredged.

About 400 linear feet of the outer end of the pier was carried away by ice floes March 24, 1898.

In April, 1897, the average depth was about 5 feet.

There have been no operations during the fiscal year ending June 30, 1898, on which date the average depth was about 5.5 feet, and the maximum draft that can be carried is 5 feet.

The appropriation of $1,000 by act of June 3, 1896, it is believed will afford sufficient funds for the maintenance of the pier and for dredging during fiscal year ending June 30, 1900.

July 1, 1897, balance unexpended	$1,000
July 1, 1898, balance unexpended	1,000

(See Appendix I I 4.)

5. *Green Bay Harbor, Wisconsin.*—The original channel from Green Bay into the Fox River was circuitous and narrow, with but 11 feet of water at its shoalest point. The original project for its improvement was adopted in 1866 and modified in 1872, 1874, and 1892, to secure greater depth, and provides for a dredged channel 16,500 feet long, 200 feet wide, and 17 feet deep, passing through a revetted cut in Grassy Island. The project adopted in 1897 provided for increasing the width of entrance at north end of channel to 500 feet.

The Fox River below Depere, Wis., was included in the Green Bay appropriations of July 13, 1892, and June 3, 1896, and the project adopted in 1896 provides for the same depth as in the other channel.

The total amount expended up to June 30, 1897, was $347,140.12.

At that date the channel from Green Bay into the Fox River had a depth of 15 feet with a least width of 200 feet, and a depth of 17 feet with a least width of 100 feet. A channel in the Fox River below Depere, having a depth of 13 feet, was completed in 1894.

During the past fiscal year dredging has increased the width of the 17-foot channel from Green Bay into the Fox River to from 200 to 220 feet, with an entrance width of 500 feet. Dredging in Fox River below Depere increased the depth to 15 feet for a width of 100 feet, which a subsequent shoaling reduced to 14 feet.

The maximum draft that can be carried June 30, 1898, from Green Bay into the Fox River, is 16.5 feet.

Commercial statistics for 1897.—Arrivals of vessels, 589; tonnage, 239,313. Exports for 1896—flour, 19,832 tons. Imports—coal, 170,311 tons.

It is estimated that $6,600 will be required for maintenance during the fiscal year ending June 30, 1900.

July 1, 1897, balance unexpended	$25,462.38
Appropriated by act of July 19, 1897	5,000.00
	30,462.38
June 30, 1898, amount expended during fiscal year	27,308.62
July 1, 1898, balance unexpended	3,153.76

Amount (estimated) required for completion of existing project	*22,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, for continuing improvement	22,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement	6,600.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix I I 5.)

6. *Sturgeon Bay and Lake Michigan Ship Canal, Wisconsin.*—In its natural condition, Lake Michigan was separated from Sturgeon Bay, an arm of Green Bay, by a neck of land about 1⅜ miles wide, having a maximum elevation above the lake level of about 28 feet. The Sturgeon Bay and Lake Michigan Ship Canal and Harbor Company, from 1872 to 1881, constructed across this neck a canal without locks or gates 7,200 feet long, 100 feet wide at water surface, and 14 feet deep, and in continuation of the canal dredged a channel in Sturgeon Bay 6,100 feet long of about the same dimensions as the canal. Of the 14,400 linear feet of canal banks, 8,437 feet was provided with pile revetments. The United States assumed possession of the canal April 25, 1893. The project of 1894 provided for an extension of the revetments, with an offset of 30 feet on each side, for fender piling, and for dredging to obtain a depth of 15 feet. The modification adopted in 1896 provided for a width of 250 feet between revetments for the westerly 1,000 feet of the canal and for a channel 200 feet wide in the bay; also for widening the entire canal to 160 feet when the old revetment required rebuilding.

The total amount expended to June 30, 1897, was $115,749.50, of which amount $81,833 was for the purchase of the canal by the United States.

The expenditures during the fiscal year ending June 30, 1898, were chiefly for extending the canal revetments 1,779 feet and dredging 44,165 cubic yards of material. There remain to be revetted on the north side of the canal 351 feet, and on the south side 1,000 feet.

The canal affords a considerable shortening of distance for many vessels over the natural outlet of Green Bay into Lake Michigan, avoids the dangers of the natural route, and makes Sturgeon Bay available and accessible as a harbor of refuge for vessels on Lake Michigan with a draft of less than 14 feet..

The maximum draft that can be carried June 30, 1898, is 14.5 feet.

Commercial statistics for 1897.—Number of vessels passing through the canal, 4,414; tonnage, 1,685,981. Bound up, lumber, 564,818 tons; bound down, coal, 15,785 tons.

* For dredging Fox River below Depere, Wis.

July 1, 1897, balance unexpended	$16,083.50
June 30, 1898, amount expended during fiscal year	15,517.48
July 1, 1898, balance unexpended	566.02
July 1, 1898, outstanding liabilities	246.60
July 1, 1898, balance available	319.42
Amount (estimated) required for completion of existing project	63,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	30,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix I I 6.)

7. *Operating and care of Sturgeon Bay and Lake Michigan Ship Canal, Wisconsin.*—Under an allotment from the indefinite appropriation of July 5, 1884, for "operating and care of canals and other works of navigation," there has been expended during the fiscal year ending June 30, 1898, $15,037.58. The principal work has been the renewal and repairs to canal revetments and dredging. The slip near the eastern entrance to the canal was extended 500 feet, a new slip 400 feet long in front of the office completed, a watchhouse at the westerly end of the canal built, 474 linear feet of the north revetment and 1,185 linear feet of the south revetment repaired; the riprap protection along the harbor front was repaired with additional stone; the grounds adjacent to the canal buildings were graded and the buildings painted; the pile driver repaired, and 35,944 cubic yards of material dredged from the canal.

About 2,700 linear feet of the revetment is in a very dilapidated condition and needs rebuilding.

Navigation through the canal opened April 12, 1897, was maintained until closed by ice December 22, 1897, and reopened April 4, 1898. No serious groundings occurred in the canal on account of an insufficient depth of water.

The water reached its lowest stage for the year on January 2, 1898, when it was 5.91 feet below high-water mark of 1838, and its highest stage June 3, 1898, when it was 3.86 feet below that point.

For commercial statistics, see report on Sturgeon Bay and Lake Michigan Ship Canal, Wisconsin.

(See Appendix I I 7.)

8. *Sturgeon Bay Canal harbor of refuge, Wisconsin.*—Before the construction of this harbor was undertaken the Lake Michigan entrance to the Sturgeon Bay and Lake Michigan Ship Canal was entirely unprotected from storms from northeast to southwest.

The project of constructing a harbor of refuge at this point was adopted in 1873, and modified in 1879 and 1880. The modified project, as carried out and completed in 1884, consists of two piers, each 1,344 feet long, 850 feet apart at the shore line, protecting the lake entrance of the canal, and converging so as to make the harbor entrance 335 feet wide, inclosing an area of about 10 acres, with a depth of at least 17 feet.

The total expenditure at this harbor up to June 30, 1897, was $179,199.20. This expenditure resulted in the completion of the piers as projected, and in a dredged channel 17 feet deep and 150 feet wide from the 17-foot contour in Lake Michigan to the canal entrance.

The expenditures during the fiscal year ending June 30, 1898, have been for repairs to the piers, redredging, and repairs to the dredging plant.

The commercial statistics for this harbor will be found in report on Sturgeon Bay and Lake Michigan Ship Canal.

On March 20, 1898, there was a channel 17.5 feet deep, 180 feet wide at the harbor entrance, and 80 feet wide at the entrance of the canal.

The maximum draft that can be carried June 30, 1898, is 17 feet.

It is estimated that $5,500 will be required for maintenance during fiscal year ending June 30, 1900.

July 1, 1897, balance unexpended	$3,983.30
June 30, 1898, amount expended during fiscal year	2,688.35
July 1, 1898, balance unexpended	1,294.95
July 1, 1898, outstanding liabilities	137.16
July 1, 1898, balance available	1,157.79
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	5,500.00

(See Appendix I I 8.)

9. Ahnapee Harbor, Wisconsin.—Previous to the improvement of this harbor the depth of water at the mouth of the Ahnapee River was only 3 feet.

The project of improvement adopted in 1875, and modified in 1884, provided for the formation of a small artificial harbor, connected with the lake by a channel 100 feet wide and 13 feet deep, formed by the construction of two piers extending to the 19-foot contour, with a 200-foot entrance channel between the pierheads.

By a modification of project adopted in 1897 further extension of the piers was abandoned.

The total amount expended up to June 30, 1897, was $176,240.18, resulting in the construction and maintenance of two piers—the north one 1,102 feet long, and the south one 1,125 feet—and 225.6 linear feet of guide piling; in the removal of 30,528 cubic yards of rock and 147,643 cubic yards of sand and gravel.

In April, 1897, there was a channel 12 feet deep, with a least width of 75 feet. Dredging done during the past fiscal year has increased the depth in the channel to 13 feet. The average depth in the basin is about 10 feet.

The maximum draft that can be carried in the channel, June 30, 1898, is 12.5 feet.

Commercial statistics for 1897.—Arrivals of vessels, 716; tonnage, 472,642. The exports and imports, as reported for 1897, are 23,561¼ and 10,285¾ tons, respectively, by all ways of transportation, their approximate values being $1,120,380 and $986,386.

July 1, 1897, balance unexpended	$6,979.82
June 30, 1898, amount expended during fiscal year	2,293.65
July 1, 1898, balance unexpended	4,686.17
Amount (estimated) required for completion of existing project	13,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	13,000.00

(See Appendix I I 9.)

10. Kewaunee Harbor, Wisconsin.—The original entrance to the Kewaunee River was not more than 20 feet wide, with a depth of about 3 feet at its shoalest point, and was obstructed by submerged bowlders.

The project for its improvement, adopted in 1881, provided for an artificial entrance channel 15 feet deep, located about 2,000 feet south

of the river mouth, protected by two parallel piers 200 feet apart, extending from the shore to the 19-foot contour in the lake.

The total amount expended on this harbor up to the close of the fiscal year ending June 30, 1897, was $129,682.67, in addition to which the local harbor commissioners had expended $8,042.72. At that time 1,700 feet of the north pier and 1,625 feet of the south pier had been constructed, and there was a depth in the channel of 15 feet, with a least width of 95 feet. In April, 1898, there was a channel 15 feet deep with a least width of 100 feet.

The maximum draft that can be carried June 30, 1898, is 14.5 feet.

During the past fiscal year both piers have been extended to the full projected length, and the channel has been dredged, thus completing the present project.

Commercial statistics for 1897.—Arrivals of vessels, 925; tonnage, 476,187. By way of harbor: Total approximate value of exports, $6,964,600; of imports, $4,142,765.

It is estimated that $8,800 will be required for maintenance during fiscal year ending June 30, 1900.

July 1, 1897, balance unexpended	$20,331.33
June 30, 1898, amount expended during fiscal year	20,109.66
July 1, 1898, balance unexpended	221.67
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	8,800.00

(See Appendix I I 10.)

11. Two Rivers Harbor, Wisconsin.—The original depth of the entrance to Twin Rivers was from 3 to 4 feet. The project adopted in 1870 provided for a 13-foot channel between parallel piers 270 feet apart, extending from the shore line to the 19-foot contour in Lake Michigan. In 1875 the distance between the piers was reduced 40 feet. In 1897 the project was modified by abandoning any further extension of the piers.

The amount expended thereon up to the close of the fiscal year ending June 30, 1897, was $214,237.49.

At that date the depth in the channel was 13 feet, with a width of 150 feet.

In May, 1898, there was a channel 13 feet deep with a width at entrance of 75 feet. A bar with a least depth of about 10 feet over it had formed at the entrance.

The maximum draft that can be carried June 30, 1898, is 12.5 feet.

The superstructure of the pile piers is in a dilapidated condition, and the sheet piling does not prevent the passage of sand through the piers into the channel.

Commercial statistics for 1897.—Arrivals of vesels, 1,664; tonnage, 255,713; exports, 10,919 tons; imports, 51,280.5 tons.

It is estimated that $10,000 will be required for maintenance during fiscal year ending June 30, 1900.

July 1, 1897, balance unexpended	$262.51
June 30, 1898, amount expended during fiscal year	42.78
July 1, 1898, balance unexpended	219.73
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	10,000.00

(See Appendix I I 11.)

12. Manitowoc Harbor, Wisconsin.—The original depth of water at the mouth of the Manitowoc River was about 4 feet at the shoalest point. The original project, adopted in 1852, provided for a channel 13 feet deep between parallel piers 220 feet apart, and was completed in 1871. In 1881 a modification was adopted to secure 19 feet at the entrance and 15 feet at the shore line by pier extension and dredging, and was completed in 1889. In 1890 a project was adopted for an exterior breakwater 400 feet long to afford protection to vessels entering the harbor during northeast storms. In 1896 a project was adopted for a channel 20 feet deep by extending the south pier and by dredging. The amount expended thereon up to the close of the fiscal year ending June 30, 1897, was $355,381.93.

At that date the exterior breakwater was completed and the project of 1896 was under construction. Soundings taken May, 1897, showed a channel 18 feet deep with a width of about 110 feet. In June, 1898, it was 20 feet deep and 160 feet wide.

The maximum draft that can be carried June 30, 1898, is 19.5 feet.

During the past fiscal year the south pier has been extended 500 feet and the channel dredged to a depth of 20 feet, thus completing the present project.

Commercial statistics for 1897.—Arrivals of vessels, 1,677; tonnage, 2,121,615. Total approximate value of imports by way of harbor, $3,000,000; exports, $6,600,000.

Amount estimated for fiscal year ending June 30, 1900, for maintenance is $3,300.

July 1, 1897, balance unexpended	$45,098.57
June 30, 1898, amount expended during fiscal year	39,111.85
July 1, 1898, balance unexpended	5,986.72
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	3,300.00

(See Appendix I I 12.)

13. Sheboygan Harbor, Wisconsin.—The entrance to this harbor had originally a depth not exceeding 7 feet. The original project, adopted in 1866, had for its object a 13-foot channel between approximately parallel piers. This project was modified in 1873 to secure a deeper channel, and in 1881 by extending the piers to the 21-foot contour in the lake and dredging to a depth of 19 feet at the outer ends, gradually diminishing to 15 feet at their shore ends. In 1894 the project was modified to provide for a uniform width between the piers by reconstructing about 1,200 linear feet of the inner end of the south pier and removing the old pier, by dredging, etc.

The amount expended thereon up to the close of the fiscal year ending June 30, 1897, was $382,049.43.

At that date there remained about 100 feet of each pier to be built; 1,000 feet of the new pile pier had been built, and some dredging done in the channel. In May, 1897, there was a channel 19 feet deep with a least width of 70 feet.

On June 30, 1898, there was a channel 19 feet deep with a least width of 80 feet.

The maximum draft that can be carried June 30, 1898, is 18.5 feet.

During the fiscal year the new pile pier has been completed, the old pier removed, and the channel widened.

Commercial statistics for 1897.—Arrivals of vessels, 1,093; tonnage, 580,980. By all ways of transportation: Exports, furniture, 18,000 tons; imports, coal, 290,000 tons.

Amount estimated for fiscal year ending June 30, 1900, for improvement of the harbor and for maintenance is $20,000.

July 1, 1897, balance unexpended	$12,399.48
June 30, 1898, amount expended during fiscal year	9,153.51
July 1, 1898, balance unexpended	3,245.97
Amount (estimated) required for completion of existing project	26,600.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, including maintenance	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix I I 13.)

14. Port Washington Harbor, Wisconsin.—The natural channel at the mouth of the Sauk River was narrow, and at the shoalest point had a depth of 1 foot.

The original project for the improvement of this harbor was adopted in 1869, and provided for two parallel piers extending to 11 feet of water in Lake Michigan and the excavation of an interior basin. This plan was modified in 1870 and again in 1876, and now provides for the excavation of two interior basins with a combined area of 5¾ acres and a depth of 13 feet and a channel of the same depth connecting the basins with the lake between piers extending to the 15-foot contour.

The amount expended thereon up to the close of the fiscal year ending June 30, 1897, was $191,377.58.

The piers were completed in 1893 and the channel and basins had been excavated to their required depth. In May, 1897, the governing depth was 12 feet. May, 1898, the governing depth was also 12 feet.

The maximum draft that can be carried June 30, 1898, is 11.5 feet.

During the fiscal year the superstructure of the piers has been partly rebuilt and needed repairs made.

Commercial statistics for 1897.—Arrivals of vessels, 1,088; tonnage, 87,300; value of exports and imports by way of the harbor, $1,260,000 and $1,132,000, respectively.

It is estimated that $4,400 will be required for maintenance during the fiscal year ending June 30, 1900.

July 1, 1897, balance unexpended	$3,158.92
June 30, 1898, amount expended during fiscal year	1,533.97
July 1, 1898, balance unexpended	1,624.95
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement	4,400.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix I I 14.)

15. Harbor of refuge, Milwaukee, Wis.—Milwaukee Bay, in which the harbor of refuge is located, is protected by the coast from storms from all directions except from northeasterly to southeasterly, and, while the anchorage ground was good, vessels were in danger of dragging their anchors or of failing to effect an anchorage at the proper place.

A Board of Engineers, in its report dated April 21, 1881, recommended a plan for a breakwater to inclose a portion of the bay 417 acres in extent, beyond the 19-foot contour, and about twice that area beyond the 13-foot contour. Work began in 1881, and up to June 30, 1897, there had been expended $626,314.44, resulting in the completion of 4,650 feet of substructure and 4,150 feet of superstructure and extensive repairs. The harbor is now used to a considerable extent as a shelter from easterly storms, and its value will rapidly increase as the breakwater is extended.

Under the contract of January 13, 1897, the breakwater has been extended 1,500 feet during the fiscal year. Necessary repairs have been made.

While the completion of the work permitted by the appropriation in the sundry civil act approved June 4, 1897, will furnish a breakwater which will be of much benefit to commerce, there will be required further appropriations of about $155,650 to fully complete it in accordance with modified plans and which the interests of commerce will justify. An estimate of this amount is presented for the consideration of Congress.

The commercial statistics are the same as for Milwaukee Harbor.

July 1, 1897, balance unexpended	$173,685.56
June 30, 1898, amount expended during fiscal year	133,749.12
July 1, 1898, balance unexpended	39,936.44
July 1, 1898, amount covered by uncompleted contracts	34,616.09
July 1, 1898, balance available	5,320.35
Amount (estimated) required for completion of existing project	155,650.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	75,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix I I 15.)

16. Milwaukee Harbor, Wisconsin.—The original depth of water at the mouth of Milwaukee River was not more than 4½ feet. The original project, adopted in 1852, provided for a channel 13 feet deep between parallel piers located about 3,000 feet north of the natural mouth of the river. In 1868 this project was modified to secure a channel 19 feet deep by extension of piers and dredging.

The amount expended thereon up to the close of the fiscal year ending June 30, 1897, was $351,608.49.

The harbor piers were completed to their projected length in 1872.

In April, 1897, there was a channel between the piers 130 feet wide and 19 feet deep.

In May, 1898, there was a channel 19 feet deep, with a least width of 90 feet.

The maximum draft that can be carried June 30, 1898, is 18.5 feet.

The project for the improvement of this harbor is completed. Repairs to piers are greatly needed.

Commercial statistics for 1897.—Arrivals of vessels, 5,983; tonnage, 4,657,539.

Of the harbors on Lake Michigan this is the second in importance. It is estimated that $14,000 will be required for maintenance during the fiscal year ending June 30, 1900.

July 1, 1897, balance unexpended	$1,816.87
June 30, 1898, amount expended during fiscal year	632.79
July 1, 1898, balance unexpended	1,184.08
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	14,000.00

(See Appendix I I 16.)

17. South Milwaukee Harbor, Wisconsin.—The entrance to this harbor originally varied in depth from absolute closure to about 3 feet. The project of improvement adopted in 1896 provides for a channel 18 feet deep, 200 feet wide, between parallel piers, at an estimated cost of $138,000.

The amount expended thereon up to the close of the fiscal year ending June 30, 1897, was $35.89.

At that date no extension had been made to the piers built by private parties, which are of very poor construction and of no use to commerce in their present condition. In April, 1897, there was a channel depth varying from 9 feet to nearly absolute closure.

During the past fiscal year the north pier has been extended 185 feet. The improvement of this harbor is not yet far enough advanced to make it of any value for purposes of navigation and commerce.

Commercial statistics.—There are no available statistics of arrivals and departures of vessels. Exports and imports by all ways of transportation. Exports: Tons, 16,153; value, $1,105,000. Imports: Tons, 110,837; value, $1,138,878.

July 1, 1897, balance unexpended	$4,964.11
June 30, 1898, amount expended during fiscal year	4,685.30
July 1, 1898, balance unexpended	278.81
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	133,000.00

(See Appendix I I 17.)

18. Racine Harbor, Wisconsin.—The entrance to this harbor originally varied in depth from absolute closure after storms to about 7 feet. The original project in 1842 or 1843 provided for a channel 13 feet deep between parallel piers. In 1866 the project was modified to provide a channel 16 feet deep, and further modified in 1889 for 17 feet by pier extension and dredging.

The amount expended thereon up to the close of the fiscal year ending June 30, 1897, was $320,814.01.

At that date both piers were of their projected length. In December, 1896, there was a channel 17 feet deep.

In April, 1898, there was a channel 15 feet deep, with a least width of 60 feet.

The maximum draft that can be carried June 30, 1898, is 14.5 feet.

A small amount of dredging was done in November, 1897, and minor repairs have been made to the piers. The piers permit the passage of sand to such an extent as to make it nearly impossible to maintain a channel 17 feet deep.

Commercial statistics for 1897.—Arrivals of vessels, 1,707; tonnage, 1,115,637. By all ways of transportation: Exports, 331,839 tons; approximate value, $11,421,930.66. Imports: Coal, 133,178 tons. Total approximate value of imports, $6,631,786.89.

It is estimated that $12,865 will be required for maintenance during the fiscal year ending June 30, 1900.

July 1, 1897, balance unexpended	$14,970.99
June 30, 1898, amount expended during fiscal year	14,749.88
July 1 1898, balance unexpended	221.11
Amount (estimated) required for completion of existing project	13,435.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, for continuing improvement	13,435.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement	12,865.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix I I 18.)

19. Kenosha Harbor, Wisconsin.—The original depth of water at the mouth of Pike Creek varied from nothing to 4 feet. The original plan of improvement was adopted in 1852 and had for its object a channel 13 feet deep, to be secured by constructing parallel piers and dredging between them. In 1889 the project was modified to secure 16 feet by pier extension and dredging. The river and harbor acts of September 19, 1890, and June 3, 1896, required dredging in the basin just inside the harbor piers.

The amount expended thereon up to the close of the fiscal year ending June 30, 1897, was $281,016.90.

At that date there remained to be constructed 150 linear feet of north pier and 250 linear feet of south pier, and there was a channel 16 feet deep with a least width of 100 feet, and a depth of 15 feet over an area of about 3 acres in the basin.

During the past fiscal year the south pier has been extended 250 feet, the full length contemplated. Repairs have been made to the piers.

Soundings taken in April, 1898, showed a channel 16 feet deep with a least width of about 70 feet, and a depth of 15 feet in the basin.

The maximum draft that can be carried June 30, 1898, is 15.5 feet.

Commercial statistics for 1897.—Arrivals of vessels, 278; tonnage, 44,400. The approximate exports and imports by all ways of transportation, as reported by Mr. H. S. Van Ingen, were: Exports, 69,896 tons; value, $15,000,000. Imports, 242,556 tons; value, $10,000,000.

It is estimated that $15,250 will be required for maintenance during the fiscal year ending June 30, 1900.

July 1, 1897, balance unexpended	$18,290.51
June 30, 1898, amount expended during fiscal year	16,702.53
July 1, 1898, balance unexpended	1,587.98
Amount (estimated) required for completion of existing project	9,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, for continuing improvement	9,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement	15,250.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix I I 19.)

20. Waukegan Harbor, Illinois.—There was no navigable channel or natural harbor at this place. The project of improvement, adopted in 1880, had for its object the construction of an artificial harbor of sufficient capacity for local trade by inclosing a portion of Lake Michigan with pile piers, the entrance channel and inclosed area to be dredged

to 13 feet. In 1882 this project was modified by reducing the area of the exterior basin, and by obtaining the additional space needed by dredging an interior basin connected by a narrow channel with the exterior basin. It has become necessary to abandon the interior basin because the land required was not secured for the purpose, and it is now practically impossible to secure possession. The present project provides for a basin 300 feet wide and 967 feet long.

The amount expended thereon up to the close of the fiscal year ending June 30, 1898, was $198,524.24.

At that date both piers had been completed to their projected length, and in April, 1897, there was a depth in the channel, and over about three-fourths of the basin, of 13 feet.

Dredging under contract during the past fiscal year extended this depth over nearly the entire basin. Dredging now in progress by the city of Waukegan will increase the depth to 18 feet for a width of 60 feet.

The maximum draft that can be carried June 30, 1898, is 12.5 feet.

The project for the improvement of this harbor is completed. Repairs to piers are now in progress.

Commercial statistics for 1897.—Exports, total tons, 194,410; imports, total tons, 351,294.5.

It is estimated that $5,500 will be required for maintenance during the fiscal year ending June 30, 1900.

July 1, 1897, balance unexpended	$16,475.76
June 30, 1898, amount expended during fiscal year	14,499.51
July 1, 1898, balance unexpended	1,976.25
July 1, 1898, outstanding liabilities	12.25
July 1, 1898, balance available	1,964.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	5,500.00

(See Appendix I I 20.)

21. Fox River, Wisconsin.—The Fox and Wisconsin rivers, separated at Portage City, Wis., by a distance of only 2 miles, one flowing into Lake Michigan, the other into the Mississippi River, were the early means of communication between those waters. In 1846 Congress granted to the State of Wisconsin a quantity of land for the purpose of improving the navigation of this route. By means of a board of public works the State began and carried on the improvement until 1853, when it was transferred to a private company. In 1872 the United States acquired possession of the property, with the exception of the water power, water-power lots, and personal property. The earliest project, that of 1848, called for canals 40 feet wide at bottom and 4 feet deep, with locks 125 feet long and 30 feet wide. This project was enlarged subsequently. The present project is that of a Board of Engineers, submitted September 17, 1884, and modified May 14, 1886. It provides for deepening and widening the channel of the Fox River from Montello to Green Bay to 6 feet depth and 100 feet width, and from Portage to Montello to 4 feet depth, and for the renovation of 12 old locks.

The amount expended on the Fox and Wisconsin rivers from 1867 to the close of the fiscal year ending June 30, 1897, including $145,000

paid to the Green Bay and Mississippi Canal Company for its property, was $3,035,653.57, of which amount $370,653.57 was appropriated solely for and expended solely upon the Fox River since 1885.

The result of this expenditure upon the Fox River was the construction of 14 new stone locks; 15 dams, one of which is temporary but now being built permanent; 12 canals; a head wall and feeder at the old first lock at Appleton; a lock house and warehouse at Appleton first lock; a wing dam and brush and stone shore protection to the Portage levee; a masonry wasteweir and culvert at head of combined locks; guard gates at head of Kaukauna Canal; also rebuilding canal banks at Kaukauna, wing walls at Kaukauna fourth lock, and 1,237 linear feet of cement-laid rubble-core wall in canal banks of fourth and fifth levels. A channel 75 feet wide and 450 feet long has been secured by blasting and drilling the rock bar below Depere Lock from 4 to 12 inches below the top of the lower miter sill. Channel below Depere has been excavated to 12½ feet depth for a width of from 50 to 60 feet, and channels deepened at mouth of Fond du Lac River, Neenah Channel, Fox River at head of Lake Butte des Morts, Grignon Rapids, below Little Chute and Rapide Croche locks, and in the canals and Upper Fox River. Masonry outlet to wasteweir at Kaukauna second lock, a roadway upon United States property at Appleton first lock, and fishways in the Eureka, Berlin, and White River dams have been constructed.

The improvement of the Wisconsin River was abandoned in 1887.

The full depth of 6 feet was obtained from Oshkosh to Depere, with the exception of the lower sill of the Menasha Lock, which has but 4 feet 6 inches over it at a low stage in the river; upon the Upper Fox the projected depth has not yet been obtained.

The expenditures during the fiscal year ending June 30, 1898, were for Princeton crib dam and fishway, and removing old dam; commencing a permanent crib dam at Grand River and removing old dam; for a harbor of refuge at Stockbridge Landing; dredging and removing snags, etc., from Wolf River; building a new 70-foot scow; repairing boats and dredges; dredging channel below Kaukauna fifth and Rapide Croche locks and canal above Rapide Croche and Appleton second locks; commencing boring of wells at Appleton first and Kaukauna second locks.

The relative value of the commerce involved and the cost of the improvement can not be estimated.

Its principal effect so far has been to cause considerable reduction in freight rates to points in the Fox River Valley.

The maximum draft that can be carried June 30, 1898, at mean low water, over the shoalest part of the improvement is from Depere to Oshkosh, 6 feet, except at Menasha Lock, where it is 4½ feet; from Oshkosh to Berlin, 5 feet; from Berlin to Montello, 4 feet, and from Montello to Portage, 3 feet.

The river and harbor act of June 3, 1896, directed that a thorough investigation of the character, limitations, and description of the property and rights of the United States in connection with the improvement of the Fox and Wisconsin rivers be made under the direction of the Secretary of War. The investigation was made by Hon. Edwd. S. Bragg and report on the subject was submitted by him February 15, 1898. The report was transmitted to Congress and printed in House Doc. No. 389, Fifty-fifth Congress, second session. It is also submitted herewith as part of Appendix I I 21.

July 1, 1897, balance unexpended	$35,596.43
June 30, 1898, amount expended during fiscal year	23,086.19
July 1, 1898, balance unexpended	12,510.24
July 1, 1898, outstanding liabilities	1,240.64
July 1, 1898, balance available	11,269.60

Amount (estimated) required for completion of existing project	180,866.48
Amount that can be profitably expended in fiscal year ending June 30, 1900	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix I I 21.)

22. Operating and care of locks and dams on Fox River, Wisconsin.—Under an allotment from the indefinite appropriation for "operating and care of canals and other works of navigation," there has been expended during the year ending June 30, 1898, the sum of $62,597.03. The principal work has been rebuilding the Kaukauna fifth lock and wasteweir; backing Depere Lock and completing retaining wall at Depere Dam; completing repairs to Little Kaukauna Dam; backing Rapide Croche and Little Chute dams and building needle houses for same; at Kaukauna, repairing lock and dam and fencing United States property; building core wall at Little Chute first lock; backing Cedars Dam; at Appleton, repairing Taintor gates of lower and upper dams, wasteweir at third lock, and building addition and repairing third lock house, repairing second lock, and fencing United States property at first lock; repairing Menasha and Eureka locks and backing Eureka Dam; at Berlin, repairing lock and building warehouse, timber shed, and repair shop; repairing White River, Princeton, and Grand River locks; repairing Montello and Governor Bend dams and Fort Winnebago Lock; repairing canal revetment of Portage Canal; repairing boats and dredges; dredging bars of Upper and Lower Fox and making incidental repairs to locks, dams, and canal banks and surveys. A detailed statement, appended to the report of the local engineer officer in charge, shows the items of expenditure.

Navigation was closed November 23, 1897, and reopened April 8, 1898, on the Upper Fox and Wolf, and April 12, 1898, on the Lower Fox River. The water in Lake Winnebago and the Lower Fox has been well maintained at the crests of the dams throughout the year, with the exception of Lake Winnebago from October 28, 1897, to March 24, 1898, drawn down by the mills by permission of the Secretary of War.

For commercial statistics, see report on Fox River, Wisconsin.

(See Appendix I I 22.)

Captain Zinn was also charged with the duty of making a survey of *Sheboygan Harbor, Wisconsin*, and report of the results will be submitted to Congress at its next session.

IMPROVEMENT OF CHICAGO AND CALUMET HARBORS AND CHICAGO AND ILLINOIS RIVERS, ILLINOIS, AND CALUMET RIVER, ILLINOIS AND INDIANA; ILLINOIS AND MISSISSIPPI CANAL.

This district was in the charge of Maj. W. L. Marshall, Corps of Engineers, having under his immediate orders Capt. Henry Jervey, Corps of Engineers, to April 14, 1898. Division Engineer, Col. J. W. Barlow, Corps of Engineers.

1. *Chicago Harbor, Illinois.*—The present project was adopted in 1870 and modified in 1878, and contemplated—

(*a*) The formation of an outer harbor or basin by inclosing a portion of Lake Michigan just south of the entrance to Chicago River by breakwaters, and dredging the same, for the purpose of increasing the harbor facilities of Chicago.

(*b*) The construction of an exterior breakwater in deep water in Lake Michigan north of the entrance to Chicago River and about 1 mile distant therefrom, to shelter the approaches to the river and outer harbor and to form a harbor of refuge near the southern end of Lake Michigan.

(*c*) To keep the entrance to Chicago River dredged for the passage of vessels navigating Chicago River as far as to the original shore line of Lake Michigan, at or near Rush Street Bridge.

This project was extended to include the improvement of Chicago River for vessels drawing 16 feet of water, by the river and harbor act of June 3, 1896, which extended project is now reported separately.

There has been expended upon this project up to June 30, 1898, $1,801,233.96, including $25,000 allotted from the appropriation of August 18, 1894, for dredging Chicago River, of which amount $3,645.70 was expended for dredging from the mouth of the river to Rush Street Bridge, and $21,354.30 applied to dredging the river from its mouth to the Stock Yards, on South Branch, and to Belmont avenue, on the North Branch.

Originally the mouth of Chicago River was obstructed by a sand bar, across which a varying depth of water existed, suitable for light-draft navigation. The piers at the mouth of the river have been projected beyond this bar, and at present there exists a channel sufficient for vessels drawing 17 feet of water.

All of the work under the projects of 1870–1878 has been done, except dredging the outer basin; and the piers, breakwaters, and channel have been maintained in good order.

The piers at the entrance to Chicago River, the exterior breakwater, and the breakwaters of the outer basin are now in excellent condition, except about 500 linear feet of superstructure over the southerly breakwater, outer basin, which will soon need rebuilding. Some stone filling is also needed in this breakwater.

All of the old piers near the mouth of Chicago River now within the shore line have been practically abandoned by the United States as forming part of the bulkheads or wharves of Chicago River, except that portion of the south pier forming the north limit of the Illinois Central Railroad Docks.

The outer basin continues to fill in, and in its present condition is useless as a roadstead except for small vessels drawing less than 12 feet of water.

To give in this basin a depth of 18 feet below Chicago city datum, or 20 feet below the mean level of Lake Michigan, 2,058,000 cubic yards of dredging is required.

It would be now advantageous to do this work.

A bulkhead has been constructed by the local authorities along the dock line in the outer harbor; and the area between this dock line and the shore line, except a small yacht basin at the southern end of the harbor, is now being filled in for a public park.

July 1, 1897, balance unexpended	$10,058.39
July 30, 1898, amount expended during fiscal year	662.19
July 1, 1898, balance unexpended	9,396.20

(*See Appendix J J 1.*)

2. Chicago River, Illinois.—This river, as far as its navigable water extends, is entirely within the limits of the city of Chicago, Ill. Originally a sluggish stream, navigable for vessels that could pass the bar at its mouth, it is now one of the most important commercial or navigable nontidal waters of its length in the world. Prior to the act of June 3, 1896, no work had been done for the improvement of its navigation by the United States. The present project, inaugurated by Congress under the act of June 3, 1896, as modified by the act of June 4, 1897, contemplates the improvement of the river by dredging and minor changes in docks and dock lines to admit passage by vessels drawing 16 feet of water.

The depth adopted and authorized has been absolutely determined by the crown of the Washington and La Salle street tunnels, beyond which depth it is again limited to 18 feet by the Van Buren Street Tunnel.

The dimensions of vessels, other than depth of hold and draft, is further limited by the bridges, bends, and width between docks.

The river and harbor act of August 18, 1894, allowed $25,000 from the appropriation made for the improvement of Chicago Harbor to be applied to the improvement of Chicago River between the mouth of the river and the junction of the two branches, of which amount $3,645.70 was expended in the year ending June 30, 1896, in dredging to 18 feet depth as far as to Rush Street Bridge. Since the passage of the act of June 3, 1896, the balance of this amount has been transferred to the Chicago River work.

Up to the close of the fiscal year ending June 30, 1898, there has been expended in dredging Chicago River $137,126.70, including the $25,000 allotted as above stated, as a result of which expenditure the river has been dredged to a depth of 17 feet below Chicago city datum from the mouth of the river to Ashland avenue on the South Branch and West Fork, and to the Stock Yards on the South Fork, South Branch, a distance of about 6 miles, and redredged from the Stock Yards to Washington street, and to near Fullerton avenue on the North Branch, including the Goose Island Cut-off, a total length in this branch of about 4 miles.

During the past fiscal year, under contract made under the conditions of the act of June 3, 1896, 854,351.3 cubic yards of earth has been taken from the river, of which 344,426.3 cubic yards has been dredged from the South Branch and 509,925 from the North Branch, leaving about 300,000 cubic yards of material still to be removed under these contracts, which are "continuing."

The river fills in rapidly from deposits from Chicago sewers and drains.

The sundry civil act of June 4, 1897, allows work to be done in widening the river by minor changes in dock lines, in addition to dredging.

The restricted channel in Chicago River is extremely hampering to all interests dependent upon commerce by water, but no practical plan of radical improvement in the condition of the channel has yet been proposed.

The dredging, as far as authorized by the act of June 3, 1896, will probably have been completed by the close of the calendar year 1898.

The funds asked for are for widening the river under the provisions of the act of June 4, 1897.

For commercial statistics, see preceding report on Chicago Harbor improvement.

July 1, 1897, balance unexpended	$138,524.79
Amount appropriated by sundry civil act approved July 1, 1898	400,000.00
	538,524.79
June 30, 1898, amount expended during fiscal year	87,651.49
July 1, 1898, balance unexpended	450,873.30
July 1, 1898, amount covered by uncompleted contracts	41,355.68
July 1, 1898, balance available	409,517.62
Amount (estimated) required for completion of existing project	137,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	137,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix J J 2.)

3. Calumet Harbor, Illinois.—This harbor is known on the Great Lakes as South Chicago Harbor.

This improvement was designed to furnish a safe and practicable entrance to Calumet River and the port of South Chicago by the construction of parallel piers 300 feet apart, projecting from the shore into Lake Michigan, and by dredging between them.

The work began in 1870 and all the projected work had been accomplished for 16-foot draft prior to June 30, 1896, resulting in the construction of 3,640 linear feet of north pier and 2,020 linear feet of the south pier, and securing and maintaining a channel 16 feet deep and of suitable width from similarly deep water in Lake Michigan to the Calumet River at the roots of the piers, at a cost of $454,483.53. The work included also 476,564 cubic yards material dredged, increasing the depth in the channel from 7 to 16 feet.

On this date, June 30, 1896, it may be considered that the original project for this locality was terminated and completed.

On June 30, 1895, a further project, based upon a survey ordered by the river and harbor act of August 18, 1894, was submitted for the further improvement of this harbor, contemplating the extension of the south pier 1,200 linear feet, of the north pier 500 linear feet, and the dredging of a channel to 20 feet depth at low water, all at an estimated cost of $154,550. (See Annual Report of Chief of Engineers for 1895, p. 2771.)

Later, upon a further call of this office, the local engineer, under date February 21, 1896, submitted a report presenting a plan for improvement of both the inner and outer harbors. The estimated cost of this improvement was $1,134,830. (See Annual Report of Chief of Engineers for 1896, p. 2584.)

The act of June 3, 1896, in appropriating for Calumet Harbor, includes the amended project of June 30, 1895, but in appropriating for the Calumet River adopts the project of February 21, 1896, in so far as relates to the 20-foot channel in harbor and river.

The projects conflict in so far as that, if the project of February 21, 1896, be adopted, the north pier need not be extended at all, and the south pier be extended only 800 linear feet, instead of 1,200 linear feet.

In view of this fact the money appropriated by the act of June 3, 1896, has been expended on that part of the two projects common to both, i. e., in extending the south pier 800 linear feet, and in dredging the harbor to 20 feet depth as far as to the junction with a similar channel, authorized by the same act, in Calumet River.

Under these projects there has been expended $69,365.18, making the total expenditures to June 30, 1898, $523,853.71.

Both works—namely, the extension of the south pier 800 linear feet, and dredging the channel from deep water in the lake to a similar depth of 20 feet in Calumet River—have been done.

The work is now in good condition, except about 500 linear feet of superstructure and the light revetment west of the Illinois Steel Company's slip, both of which need rebuilding.

The construction of the outer breakwater and the dredging of the harbor of refuge, as given in the project of February 21, 1896, is much needed.

The estimates made herein are based on the supposition that the greater of the two projects is to be carried out. If the lesser be in question, work would be done that is entirely unnecessary under the greater scheme, and the lesser project will not meet the conditions of constant shoaling in advance of the piers.

The greater project, contemplating an outer protecting breakwater and dredging in the sheltered area, is a necessity that must sooner or later be met and satisfied.

If, however, the lesser project is to be carried out, $79,550 is required under the project of June 30, 1895, to complete the work under that project.

July 1, 1897, balance unexpended	$24,668.72
June 30, 1898, amount expended during fiscal year	11,122.43
July 1, 1898, balance unexpended	13,546.29

Amount (estimated) required for completion of existing project of February 21, 1896	1,009,830.00
Amount (estimated) required for completion of existing project of June 30, 1895	79,550.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	150,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix J J 3.)

4. *Calumet River, Illinois and Indiana.*—The project for the improvement of this river, adopted by Congress in 1883, contemplated securing a channel 200 feet in width and 16 feet in depth below low water in Lake Michigan, from the mouth of Calumet River at Calumet Harbor, Illinois, to one-half mile east of Hammond, Ind., with a view to increasing the facilities for handling the commerce of this region and also aiding in providing means for the better accommodation of much of the commerce of Chicago River, which river was and still is much crowded.

The original depth in Calumet River varied between 6 and 10 feet.

Following a report on a survey of Calumet Harbor, Illinois, published as House Doc. No. 277, Fifty-fourth Congress, first session, also published in Annual Report of Chief of Engineers, 1896, page 2583, the project has been modified by the river and harbor act of June 3, 1896, so far as to allow the channel for 2 miles southward from the mouth of the river to be dredged to 20 feet depth.

This modification increases the estimated cost of the improvement by $51,700.

Since the improvement began in 1889 there has been dredged a channel, measured from the harbor southward, to the full width of 200 feet and depth of 16 feet, 19,518 feet in length, except that over a short portion where rock was encountered the width was reduced to 85 feet, 9,000 cubic yards or less of rock remaining to be removed to secure full width and depth over this short stretch.

Under this 16-foot project 1,767,220 cubic yards material was removed prior to June 30, 1896, from the channel "below the forks" of the Calumet. In addition there has been removed 248,516 cubic yards of material from the channel between the forks and one-half mile east of Hammond, Ind., in an effort to secure a practicable channel 10 feet deep and 60 feet wide, resulting in failure, due to rapid refilling of channel by slaughterhouse refuse, sewage, and other filth.

The amount expended by the United States on this original project prior to June 30, 1896, was $291,842.07, of which $248,715.91 has been expended "below the forks" and $43,126.16 for work between the forks and one-half mile east of Hammond, Ind.

The river and harbor act of 1896 appropriated $50,000 and authorized dredging the channel to 20-foot depth for 2 miles southward from the mouth, and under this supplementary and restricted project there has been 320,405 cubic yards of material removed under contract, completing the channel 20 feet deep a distance of 2 miles at a further cost of $50,276.35.

The total expenditures to June 30, 1898, amounted to $342,118.42.

A winding or turning basin 20 feet deep, of sufficient dimensions for the largest lake vessels yet constructed, was also dredged at the first cut-off above the mouth of the river.

The amount appropriated by the act of June 3, 1896, was found sufficient to dredge the channel to the 2-mile limit and provide the basin named at somewhat less cost than estimated February 21, 1896, due to the favorable terms secured for the work.

Similar winding or turning basins should be provided at intervals of from 1 to 2 miles along the river, to avoid in future the restrictions now imposed in other lake harbors within the shore lines.

There is at present a good 20-foot channel from the harbor to One hundred and sixth street. Above this point the 16-foot channel has deteriorated by filling in until there is now less than 16 feet. No work has been done under the regular 16-foot project above One hundred and eighteenth street.

The improvement of the river has been followed by a remarkable development of commerce, which now exceeds 4,000,000 tons per annum, or near one-half that of Chicago Harbor, the most important on the Great Lakes.

July 1, 1897, balance unexpended	$32,663.72
June 30, 1898, amount expended during fiscal year	24,782.14
July 1, 1898, balance unexpended	7,881.58
Amount (estimated) required for completion of existing project	700,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix J J 4.)

5. *Illinois River, Illinois.*—The present project was adopted in 1880, and contemplates the extension of the slack-water improvement, begun by the State of Illinois, from Copperas Creek locks to the Mississippi River, a distance of 135 miles.

The project includes the construction of two locks, 350 feet long between miter sills, 75 feet width of chamber, with 7 feet of water over sills at low-water level of 1879, and dredging the channel where necessary to obtain 7 feet depth at low water in the pools thus created.

The two locks and dams are completed and in use. One is situated at Kampsville, 31 miles above the mouth of the Illinois River, the other at La Grange, 79 miles above the mouth of the Illinois River.

The ultimate object of the improvement is the construction of a waterway from the southern end of Lake Michigan to the Mississippi River of sufficient capacity to accommodate large-sized Mississippi River steamboats and for military and naval purposes.

The State of Illinois, aided by the United States, has executed part of the project by the construction of two locks of the dimensions given—one at Henry and one at Copperas Creek—completing, except dredging, that part of the improvement between La Salle, Ill., and the mouth of Copperas Creek, a distance of about 90 miles.

In executing this work the United States has expended, up to June 30, 1898, $1,358,417.81, including $25,000 from the appropriation of August 11, 1888, for surveys, and excluding $62,359.80 expended upon a foundation for Copperas Creek Lock, afterwards completed by the State of Illinois.

An additional amount of $747,747 was expended by the State of Illinois at Henry and Copperas Creek locks and dams.

During the fiscal year ending June 30, 1898, the following work was done:

	Cubic yards.
Dredging at Macoupin Creek	26,504
At 12-Mile Island	6,386
At Moores Island (clay)	20,445
At New Camp Creek (sand)	36,778
At Wilsons Island (mud)	24,937

The appropriation, after reserving sufficient for emergency purposes, was then exhausted and the dredging plant was employed for a short while about the locks under the appropriation for "operating and care of canals, etc.," and then laid up.

Minor repairs were made to the dredging fleet.

The channel of the Illinois River is becoming the best of all the tributaries of the Mississippi River, and it is believed that the dredged channels are reasonably permanent. Large steamboats navigated the river during the year, although the water was extremely low. The very slow progress in the improvement, which has now continued for thirty years under meager appropriations, has resulted in other means of transportation and the diversion to railroads of traffic naturally tributary to the river. Under the project it was contemplated to first construct locks and dams to check or slack the current, then procure a deep channel by dredging the bars in the pools thus created. The locks and dams have been built at great expense, after long and tedious delays for money, but the channels must now be dredged to avail of their full capacity or to obtain the object sought. The dredging is the effective work. The locks and dams give from 3 to 4 feet, which the dredging must increase to 7 feet.

Since the construction of the La Grange Lock, in 1889, the traffic on the Illinois River has increased 200 per cent, and the attainment of 7 feet available depth will doubtless be followed by a materially greater increase in the use of the stream.

The funds asked for are to be expended in dredging to deepen and widen the channels.

July 1, 1897, balance unexpended	$17,282.59
June 30, 1898, amount expended during fiscal year	14,327.19
July 1, 1898, balance unexpended	2,955.40
Amount (estimated) required for completion of existing project	357,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix *J J 5.*)

6. Operating and care of La Grange and Kampsville locks, Illinois River, and approaches thereto.—These locks and dams have been operated and maintained under the indefinite appropriation provided for in section 4 of the river and harbor act of July 5, 1884.

La Grange Lock and Dam.—These works were operated and maintained in good order during the year. The drift was kept cleared from the dam; the lock gates were calked, painted, and repaired; guide piles were placed above and below the lock entrances; 1,470 cubic yards of filling was placed above the dam and low places about the grounds filled in, and the buildings and plant kept in order.

The amount expended during the year was $6,344.37.

Kampsville Lock and Dam.—Drift was cleared from the dam; clumps of guide piles driven at entrances to the lock; 400 cubic yards sediment was removed from the lock, and filling was placed above the dam and on upper side of east abutment, 4,470 cubic yards earth and 35 cubic yards riprap and gravel being used for the purpose.

Current repairs were made to lock houses and buildings; 1,650 feet plank sidewalk built and 500 cubic yards filling placed about the grounds.

Two new dump scows were built and repairs made to boats and plant.

The river was unusually low during the season, but nevertheless there was a small increase in the tonnage passing the locks over that passing in 1897.

The amount expended during the year was $7,223.31.

(See Appendix J J 6.)

7. Illinois and Mississippi Canal, Illinois.—The object of the improvement is to furnish a link in a navigable waterway from Lake Michigan to the Mississippi River at the mouth of Rock River, Illinois.

The canal has been located on the Rock Island route, approved by the Secretary of War October 27, 1888, as directed in the act of Congress of August 11, 1888. It proceeds from the Illinois River at its great bend 1¾ miles above the town of Hennepin, Ill., thence via Bureau Creek Valley and over the summit to Rock River at the mouth of Green River; thence by slack water in Rock River, and a canal around the lower rapids of the river at Milan, to the Mississippi River at the mouth of Rock River.

The canal is to be at least 80 feet wide at the water surface, 7 feet deep, and with locks 170 feet long and 35 feet width of lock chamber, capable of passing barges carrying 600 tons (maximum) freight.

A report upon the location, with detailed estimates of cost, of this canal was submitted June 21, 1890, and published (without maps) as House Ex. Doc. No. 429, Fifty-first Congress, first session, and is also printed in Annual Report of the Chief of Engineers for 1890, Part III, page 2586.

The river and harbor act of September 19, 1890, made the first appropriation for the construction of the canal, and directed work to be begun by the construction of one of the locks and dams in Rock River.

In accord with this act work was begun in July, 1892, near the mouth of Rock River on the construction of a canal around the lower rapids of the river, which barred navigation, and since that date has been prosecuted with an intermission due to lack of necessary funds. The survey work, in locating the canal on the ground, and proceedings for acquiring title to the right of way have been continuous since October, 1890, and the canal has been definitely located on the ground throughout its *entire extent.*

There has been expended on this work up to the close of the fiscal year ending June 30, 1898, $1,748,905.13, and during the fiscal year ending June 30, 1898, $545,017.58.

The result of this expenditure has been—

First. The acquisition of the right of way for 4½ miles around the lower rapids of Rock River and the completion of 4½ miles of canal there, involving the construction of 4½ miles of earthwork in constructing the canal trunk, 3 locks, 1 railroad, and 2 highway swing bridges, 7 sluiceways and gates, 1 arch culvert; 2 dams, 1,392 feet long, across the arms of Rock River; 3 lock-keepers' houses, 1 small office building, and a thorough riprapping of the canal banks, not estimated for in the original estimates.

Second. In the location on the ground and preparation of descriptions, plats, and abstracts of titles of all lands needed for the eastern section of the canal; same for feeder line and for lands to be overflowed or damaged by the dam at Sterling; the surveying and locating of the western section throughout, and the final location of the canal throughout.

Two routes each were surveyed for the feeder and for the western section, resulting in the Sterling route being accepted for the feeder and the Green River route for the western section of the canal.

Third. In the practical completion of the earthwork over the first 16 miles of canal trunk, the paving of 7 miles with stone; the foundations and masonry of 10 locks, 1 aqueduct, 5 bridges, 7 arch culverts, and 10 pipe culverts; the partial completion of erection of 5 steel highway bridges, 1 lock, and 3 miles of canal trunk.

Fourth. In the acquisition by purchase or condemnation of 24 miles of the eastern section of the canal, and the condemnation of 28.5 miles of the feeder and more than one-third of the western section, and the preparation of plans and estimates for the construction of the feeder.

During the fiscal year ending June 30, 1898, the following work has been done:

By hired labor.—The first 8 miles of the canal trunk has been lined with stone, except about 1 mile in detached parts. The filling behind 7 locks has been completed, and also the splay walls at their head. A gravel quarry has been stripped, and all gravel necessary for concrete construction has been distributed as wanted. The masonry of 3 locks, abutments of 5 highway bridges constructed and the approaches to the bridges nearly completed. Three lock houses have been built, 1 office building, and 3 temporary buildings for storage purposes. About 5 miles of extension to the narrow-gauge construction railroad has been constructed. The right of way for the feeder and more than one-third of the western section has been condemned.

By contract.—Eight miles of canal trunk have been completed, 2 miles practically completed, and 8 miles farther put under contract and work thereon begun. The foundations of 9 locks have been completed and those of 5 additional locks and 1 aqueduct are under way and well advanced. The steel superstructures of 5 bridges have been delivered and 3 of them erected. Two concrete-arch culverts and 6 pipe (cast iron) culverts have been built. The work on the eastern section is now about one-half done. All work of construction during the year has been done on the eastern section.

An assistant district attorney has been appointed to attend to all matters relating to the acquisition of the right of way for the canal. During the last year all the right of way for the feeder has been arranged for—payments of awards only remaining to acquire title—and

much of the right of way for the western section has been condemned and awards made.

The feeder will now be put under contract and the work be prosecuted as rapidly as the terms of the law permit.

July 1, 1897, balance unexpended		$906,898.91
Amount appropriated by sundry civil act approved July 1, 1898		1,427,740.00
		2,334,638.91
June 30, 1898, amount expended during fiscal year		545,017.58
July 1, 1898, balance unexpended		1,789,621.33
July 1, 1898, outstanding liabilities	$93,214.90	
July 1, 1898, amount covered by uncompleted contracts	244,785.61	
		338,000.51
July 1, 1898, balance available		1,451,620.82

Amount (estimated) required for completion of existing project	*3,433,490.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	1,427,740.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix J J 7.)

8. *Operating and care of Illinois and Mississippi Canal; canal around lower rapids of Rock River, at Milan, Ill.*—This canal is 4½ miles in length, surmounting a fall of 18 feet, and the works operated and cared for include 3 locks, 3 swing bridges, 7 sluiceways, 1 arch culvert, 3 lock houses, 1 office building, and 2 dams.

The canal was formally opened to navigation April 17, 1895.

On account of three fixed bridges across Rock River a few miles above the head of the canal, its traffic is restricted to excursion craft and to barges and to such small steam craft as may pass under the bridges.

Proceedings were instituted to compel the city of Moline to alter its bridge, but the authority of the Secretary of War was denied by the city of Moline. The United States district court for the northern district of Illinois in a preliminary ruling sustained the United States authority, and later a jury in the trial of the condemnation case of United States *v.* Maxson, brought in a special verdict finding Rock River to be a navigable water of the United States up to and past the upper rapids of Rock River at Sterling, Ill. The contention has apparently been closed by the sundry civil act of July 1, 1898, which allots $25,000 for the construction of a high bridge at the city of Moline in lieu of the existing bridge complained of.

The canal and its accessory works have been operated and maintained in good order during the past year. The main supports of sluice gates were protected by movable roofs; repairs were made to roads, lock houses, and dams; 2,650 cubic yards material at mouth of canal was removed by dredging, and willows planted along parts of the canal banks for their protection.

During the season of navigation boats and barges aggregating 94,609 tons passed the canal, carrying 20,430 tons of coal and 2,279 passengers.

The use of the canal is restricted by the obstructive bridges across Rock River above it, but the coal by canal controls the price of this necessary article at Davenport and vicinity, and this result has been

* Twenty-five thousand dollars appropriated (sundry civil act July 1, 1898) for constructing bridge across Rock River at Moline, Ill., added to amount required for completion.

in effect ever since the opening of the canal. A reduction of from 3 to 5 cents a bushel, or say $1 per ton on all soft coal used has resulted, which has already justified the construction of this part of the canal as an independent work. The change in the Moline Bridge will make this canal an important line of transportation for coal.

There was expended during the year ending June 30, 1898, $4,502.39, exclusive of $366.64 outstanding liabilities.

(See Appendix J J 8.)

IMPROVEMENT OF MICHIGAN CITY HARBOR, INDIANA, AND OF RIVERS AND HARBORS ON THE EASTERN SHORE OF LAKE MICHIGAN.

This district was in the charge of Capt. C. McD. Townsend, Corps of Engineers, to May 21, 1898, and of Lieut. Col. G. J. Lydecker, Corps of Engineers, since that date. Division Engineer, Col. J. W. Barlow, Corps of Engineers, to May 21, 1898.

1. Michigan City Harbor, Indiana.—The improvement of this harbor dates from 1836, and has resulted in establishing a convenient inner harbor for local commerce, and partly completing an outer harbor, designed to facilitate entrance to the former and afford refuge in times of northerly gales to vessels engaged in general lake commerce.

The inner harbor has been made by (1) deepening the entrance to Trail Creek and protecting the channel by piers extending to deep water in Lake Michigan, to which operations were limited until 1870, and (2) prolonging the entrance channel up the creek by dredging between revetments that are built on established dock lines at the expense of the adjoining property, as required by city ordinance. This work, commenced in 1882 and still in progress, makes the total length of the interior waterway 9,159 feet between revetments from 100 to 175 feet apart, except at the turning basins, where the width is about 350 feet.

The total expenditure to June 30, 1897, was $419,593.46, the available depth of channel then being scant 12 feet.

The principal work done during the past fiscal year was to dredge portions of the channel, the total excavation being 55,534 cubic yards, of which 21,831 was dredged in August, 1897, and 33,703 in May and June, 1898. This work made a wider and straighter channel through the harbor, with a navigable depth of about 12½ feet.

The harbor piers aggregate 3,562 feet in length, of which 1,350 feet is between 25 and 30 years old, and now need quite extensive repairs, and dredging is required annually to maintain the required depth of channel.

July 1, 1897, balance unexpended		$12,165.31
June 30, 1898, amount expended during fiscal year		5,269.82
July 1, 1898, balance unexpended		6,895.49
July 1, 1898, outstanding liabilities	$168.11	
July 1, 1898, amount covered by uncompleted contracts	3,663.86	
		3,831.97
July 1, 1898, balance available		3,063.52
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		7,500.00

The outer harbor.—This part of the improvement was commenced in 1870 under a project which provided for making an outer basin east of the entrance to the inner harbor; in 1882 this project was extended to

include the construction of an exterior breakwater northwest of the entrance. The piers and breakwaters covering the outer basin were completed in 1885 and have a total length of 3,141 feet, viz, a pile pier 1,225 feet long, extending in a northerly direction from the shore and closing the basin on the east; a crib breakwater 1,411 feet long, extending westward from the lake end of the pile pier and closing the basin on the north, and a crib pier, 505 feet long, extending northward from the west end of the crib breakwater. The exterior breakwater contemplated by the project of 1882 was to have a total length of 2,000 feet, but only 700 feet has been built.

The present condition of the outer harbor is such that it has no appreciable value as a harbor of refuge, but its piers and breakwaters combine to check the run of heavy seas into the contracted inner harbor, thereby facilitating entrance to it and giving it comparatively still water. The outer basin has an area of about 40 acres, but it can not be used for commercial purposes until a large amount of dredging has been done, and it will be of little use to do this until the exterior breakwater is completed. Further, this structure is now entirely too short to afford a reasonably safe anchorage behind it.

The total amount expended on the outer harbor to June 30, 1897, was $753,960.46, with results as indicated above. No work was done on the outer harbor during the last fiscal year, except to replace some deck plank that were carried away by the wash of heavy seas over the breakwaters and to maintain the lights at the harbor entrance.

The outer harbor will have no value as a harbor of refuge until the exterior breakwater is completed, and until this is done no benefits commensurate with the large expenditure already made can be realized. Since the adoption of the project of 1882 the draft and size of vessels have increased to such an extent as to call for a modification of that project. The subject was carefully considered by a Board of Engineers in 1897, and its recommendations are printed and illustrated by a map of the harbor in the Report of the Chief of Engineers for 1897, pages 2899 to 2904, inclusive. The estimated cost of completing the work as thus proposed is $282,150, but these figures will in all probability be largely exceeded if operations have to be extended through several seasons and carried on under small appropriations.

July 1, 1897, balance unexpended	$87,914.54
June 30, 1898, amount expended during fiscal year	1,318.66
July 1, 1898, balance unexpended	86,595.88
Amount (estimated) required for completion of existing project	159,613.56
Amount that can be profitably expended in fiscal year ending June 30, 1900	75,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix K K 1.)

2. St. Joseph Harbor, Michigan.—The improvement of the mouth of St. Joseph River was commenced more than sixty years ago, when there was a narrow and crooked channel with depths fluctuating between 3 and 7 feet. The work then commenced has developed the present harbor at this place, the entrance to which is between piers 270 feet apart. The north pier is 2,017 feet long, and, as a result of extensive repairs made during the past few years, all but a length of about 303 feet is now in good condition. The south pier is 819 feet long, and was finished in 1872, and is now such a complete wreck that it is likely to be carried away by any severe storm to which it may be exposed, and the result would be to close the entrance channel to commerce. The present

approved project of improvement calls for a navigable depth of 16 feet from Lake Michigan into and through St. Joseph Harbor, and of 13 feet from the upper end of that harbor, which is at the confluence of the St. Joseph and Paw Paw rivers, to Benton Harbor via the Benton Harbor Canal. The required depth of 16 feet has not yet been obtained at the harbor's entrance, because the piers do not extend sufficiently far into Lake Michigan. About the best that can be counted on there under existing conditions is an actual depth of from 12 to 14 feet, and that only as a result of oft-repeated dredgings. The maintenance of a navigable depth of 13 feet through the upper part of the harbor and Benton Harbor Canal is also dependent upon dredging these sections at least once, and frequently twice, each year.

The total estimated cost of improvements heretofore projected and approved is $519,113, and the total expenditure for these improvements and their maintenance to June 30, 1897, was $479,043.74.

Operations during the last fiscal year comprised dredging to the extent of 35,542 cubic yards, and radical repairs amounting to a practical reconstruction of 375 linear feet of the north pier. The result of the dredging was to maintain navigation through St. Joseph Harbor and Benton Harbor Canal, but the channel so provided was by no means equal to the requirements of the local commerce, and could not be made so because enough funds were not available for doing the necessary work. The depth at entrance became so reduced that the large steamer *City of Duluth* struck heavily in attempting to make the harbor last winter when a heavy sea was running, and became a total wreck.

The estimated cost of completing and maintaining the improvement under the present approved project is as follows: 850 linear feet of crib pier extension, $85,000; rebuilding south pier, 820 linear feet, at $25 per linear foot, $20,500; minor repairs of other parts of old piers, $2,000; dredging, two seasons, $10,000; making in all, with due allowance for engineering, supervision, and office contingencies, $127,000.

A special report in relation to a more radical plan of improvement for this harbor was submitted in response to a concurrent resolution in Congress February 1, 1898, and is printed in House Doc. 307, Fifty-fifth Congress, second session, and is submitted herewith in Appendix K K 2. The total estimated cost of the project there estimated was $380,000.

July 1, 1897, balance unexpended	$14,068.46
June 30, 1898, amount expended during fiscal	11,570.58
July 1, 1898, balance unexpended	2,497.88
July 1, 1898, outstanding liabilities	251.69
July 1, 1898, balance available	2,246.19
Amount (estimated) required for completion of existing project	100,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, including maintenance	75,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix K K 2.)

3. St. Joseph River, Michigan.—This is a very crooked stream, obstructed by numerous shoals and ripples, over which the water flows in thin sheets, with depths in channel crossings of from 24 to 30 inches; the intervening pools are generally from 4 to 8 feet deep. The only part now navigated is from the mouth, at St. Joseph, to Berrien Springs, a distance of about 25 miles by river, while the land distance between the same points is but little more than half that. The improvement of this section to make a low-water channel 3 feet deep has been in

progress since 1889, and consists in removing snags and logs and closing secondary channels, or concentrating the flow at other critical points by dams of brush, logs, and stone. The amount expended to June 30, 1897, was $4,862.02, and the depth of channel has thereby been increased to 3 feet at many of the worst places, but a number of shoals still exist where the channel depth does not exceed 30 inches.

During the past fiscal year two new dams were built, repairs were made to old ones at seven of the most troublesome shoals, and snags or logs that obstructed navigation were removed.

The cost of completing an improvement of this character depends entirely on how long the work is to be kept up and the annual cost of doing it. In the present case the average annual expenditure has been $500, and experience shows that it is too little to accomplish what is required for making and maintaining the limited improvement, but an increase to $750 would probably suffice.

July 1, 1897, balance unexpended	$637.98
June 30, 1898, amount expended during fiscal year	423.72
July 1, 1898, balance unexpended	214.26
Amount (estimated) required for completion of existing project	5,800.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	1,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix K K 3.)

4. *South Haven Harbor, Michigan.*—This harbor is the result of improvements made at the mouth of Black River since 1867 by building two parallel piers out into Lake Michigan, with revetments extending from their shore ends for a distance of about 1,000 feet up the stream, and by dredging the channel included between these piers and revetments; and for a farther distance of about half a mile up, where the highway bridge spans the river. The width of channel from Lake Michigan to the upper end of the revetments is 177 feet and above there about half that, with a turning basin about 100 feet wide at the extreme end. The total length of piers and revetments built up to the year 1888 was 3,145 feet, and no extensions have been made to them since that time. The depth of channel called for by the approved project of improvement is 12 feet, but the piers do not extend far enough into Lake Michigan for that purpose, and a depth of 10 feet is all that can be had at entrance, except when a temporary increase is provided by dredging. Before any improvement was made the depth was only 3 or 4 feet, through a narrow and unstable channel.

The estimated cost of completing the improvement, as projected, was $262,000, and the total expenditure to June 30, 1897, was $230,828.47, resulting in the construction and maintenance of the piers and revetments and in repeated dredgings of the channel.

Operations during the past fiscal year were limited to dredging, and to an unsuccessful effort of the contractor to extend the south pier 350 feet. He commenced his work July 14, 1897, and continued until September 16, when a storm disabled his working plant and destroyed most of his work. Operations were resumed May 10, 1898, and were in progress at the close of the year. The dredging which was done between May 26 and June 13, 1898, amounted to 13,766 cubic yards, and the better channel thus obtained will probably afford a navigable depth of 11 or 12 feet during the most busy part of the year 1898.

When the south pier extension now in progress is finished the present approved project of construction will be completed, but the navigable

depth called for by that project can not be obtained and kept until both piers are extended to at least the 14-foot curve in Lake Michigan; this would require further extensions of 300 and 100 feet to the north and south piers, respectively, but no estimate for such work has yet been called for or authorized.

For maintenance of the improvement extensive repairs of the old piers are urgently needed, and annual dredging can not be dispensed with if navigation is to be kept up; at least $15,000 is required for these purposes, including supervision, engineering, and office expenses.

July 1, 1897, balance unexpended		$21,171.53
June 30, 1898, amount expended during fiscal year		4,807.84
July 1, 1898, balance unexpended		16,363.69
July 1, 1898, outstanding liabilities	$516.29	
July 1, 1898, amount covered by uncompleted contracts	11,652.00	
		12,168.29
July 1, 1898, balance available		4,195.40
Amount (estimated) required for completion of existing project		45,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900		15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix K K 4.)

5. *Saugatuck Harbor, Michigan.*—This harbor is at the mouth of the Kalamazoo River, where the channel depth before improvement was generally not over 5 feet. Its condition was first improved by a private company, which built two slab piers for confining the river current, and thereby obtained a channel depth of 7 feet, temporarily. Its further improvement was commenced by the General Government in 1869, and from that time to 1882 the piers were extended and interior channel revetments constructed until they had a total length of 1,907 feet on the north and 3,863 feet on the south side, all of pile work. Since 1882, appropriations having been too small to keep these structures in repair, they have gradually gone to decay, and the navigable channels opened through the harbor from time to time by dredging fill up again very soon after the departure of the dredge.

The estimates made from time to time for carrying on the work aggregate $175,699.46, and the total expenditure to June 30, 1897, was $158,760.11, with results as indicated in the foregoing paragraph.

Operations during the past fiscal year were limited to dredging as usual; the total amount dredged was 24,553 cubic yards, of which 15,632 cubic yards was done in July, 1897, and the remainder in June, 1898, and the result was to open the channel for a short time during the busiest part of each year.

The port of shipment through this harbor is the town of Saugatuck, 3 miles above the entrance from Lake Michigan, and the natural difficulties of making and maintaining a reliable navigation by the present line of water travel led to an alternative project, which is printed in the Annual Report of the Chief of Engineers for 1896, pages 2741 to 2743, and the river and harbor act of June 3, 1896, provided as follows concerning it:

Improving Kalamazoo River, Michigan, from Lake Michigan to Saugatuck, in accordance with the alternative project submitted January twenty-eighth, eighteen hundred and ninety-six, five thousand dollars.

The same act appropriated $10,000 "for improving harbor at Saugatuck, Mich., continuing improvement" in order to provide for keeping

the old route open until the proposed new one could be established. A like amount is now needed for the same purpose, as no adequate provision has yet been made for carrying out the alternative project. (See Kalamazoo River, below.)

July 1, 1897, balance unexpended		$8,678.89
June 30, 1898, amount expended during fiscal year		6,580.05
July 1, 1898, balance unexpended		2,098.84
July 1, 1898, outstanding liabilities	$1,354.94	
July 1, 1898, amount covered by uncompleted contracts	513.06	
		1,868.00
July 1, 1898, balance available		230.84
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		10,000.00

(See Appendix K K 5.)

6. *Kalamazoo River, Michigan.*—The project for improving Kalamazoo River is the alternative one referred to above, in connection with Saugatuck Harbor. It provides for making a navigable channel, 12 feet deep, from the town of Saugatuck to Lake Michigan, by dredging the river for a distance of 1¾ miles below the town, and thence making a new cut from the river to the lake. The estimated cost is $150,000.

The river and harbor act of June 3, 1896, appropriated $5,000 for the work, but as its principal feature is the proposed cut it would be unwise to enter upon the project until sufficient money is appropriated to excavate it and insure its permanence by constructing the necessary revetments on its sides. For this reason no work has yet been done.

July 1, 1897, balance unexpended	$5,000.00
June 30, 1898, amount expended during fiscal year	.25
July 1, 1898, balance unexpended	4,999.75
Amount (estimated) required for completion of existing project	145,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	50,000.00

(See Appendix K K 6.)

7. *Holland (Black Lake) Harbor, Michigan.*—The first steps toward establishing a harbor at this place were taken by the citizens of Holland, Mich., situated on Black Lake, about 5 miles from the present harbor, by opening a channel having a navigable depth of about 5 feet from the lake into Lake Michigan, and protecting it by piers and revetments made of brush and stone. Continuation of this improvement was taken in hand by the General Government in 1867, existing structures strengthened by pile and crib work, and extended until in 1880 the north pier and revetment had attained a total length of 1,854 feet and the south pier 1,691 feet. They have remained without extension since that time. The estimated cost of the present approved project was $291,615.13, and the amount expended to June 30, 1897, was $299,533.76. The results thereby attained have been the construction and maintenance of piers and revetments aggregating 3,545 feet in length, covering a channel way from 175 to 220 feet wide, in which a depth of 8 to 9 feet prevails, deepened by occasional dredging to 12 or 13 feet.

The expenditures during the past fiscal year were applied to rebuilding 203 linear feet of the old north pier and to dredging 12,088 cubic yards of material from the channel way. As a result of dredging, just

then completed, the maximum available depth at the shoalest part of the channel June 30, 1898, was 12 feet. The proposed depth of 12 feet can not be maintained until considerable portions of the old piers are rebuilt and extensions of about 400 feet made to each. The estimate submitted below relates to repairs of the old work only, the extension of the piers being as yet unauthorized.

A special report relating to this harbor, dated January 5, 1897, was made to Congress under the provisions of river and harbor act of June 3, 1896, which called for an estimate of the cost of making and maintaining a navigable channel 16 feet deep. This report is printed as House Doc. No. 272, Fifty-fourth Congress, second session, and in Annual Report, Chief of Engineers for 1897, page 2950. The estimated cost of the work contemplated by the project then submitted was $240,000.

July 1, 1897, balance unexpended	$5,080.36
June 30, 1898, amount expended during fiscal year	4,501.66
July 1, 1898, balance unexpended	578.70
July 1, 1898, outstanding liabilities	169.23
July 1, 1898, balance available	409.47
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	15,000.00

(See Appendix K K 7.)

8. *Grand Haven Harbor, Michigan.*—This harbor is at the mouth of the Grand River, which had a shifting channel, with a depth of 9 feet at its mouth, before improvement. The first step in the line of improvement was taken by the Detroit, Grand Haven and Milwaukee Railroad Company, by constructing a pier on the south side to provide for the interchange of traffic between the railroad and its translake line of steamers. Its systematic improvement was commenced by the Government in 1867, and has resulted in the establishment of a harbor that not only satisfies the needs of an extensive local commerce, but gives to general commerce its only harbor of refuge from westerly gales on this coast south of Grand Traverse Bay.

At the beginning of the last fiscal year the north pier and revetment was 3,538 feet long and projected 1,472 feet beyond the shore line; the south pier and revetment was 5,774 feet long and projected 1,681 feet beyond the shore line.

The total estimated cost of improvements heretofore authorized amounts to $804,366.15; the total expenditure to June 30, 1898, was $738,767.73, resulting in building and maintaining the piers and revetments referred to above and in doing a large amount of dredging for gaining and keeping the required channel depth.

The expenditures during the last fiscal year were applied to minor repairs of crib work and to refilling them in part, and to dredging 40,942 cubic yards of material from the interior channel way.

The formation of the shoal in front of the entrance is the principal difficulty that has to be contended with in the improvement of this harbor; pier extension alone will not solve the problem. The principal element that contributes to its formation is the sand blown into the harbor from the adjoining uncovered sand dunes, and then carried by the body of water flowing out of Grand River through the contracted waterway between the piers until the current is checked on spreading into Lake Michigan and no longer able to uphold its load of sand.

It then falls to the lake bed and goes toward the upbuilding of the shoal. The remedy is to cut off the supply of sand by a growth of vegetation on the dunes adjoining the harbor and supplement this with a suitable combination of sand fences. With this done and the piers extended, as required by the present approved project, a channel depth of full 18 feet at entrance may be counted upon. Nothing less will satisfy the important requirement of making this a safe harbor of refuge.

July 1, 1897, balance unexpended	$32,100.38
June 30, 1898, amount expended during fiscal year	11,501.96
July 1, 1898, balance unexpended	20,598.42
July 1, 1898, outstanding liabilities	155.40
July 1, 1898, balance available	20,443.02
Amount (estimated) required for completion of existing project	45,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	30,000.00

(See Appendix K K 8.)

9. Grand River, Michigan.—Between 1881 and 1886 $50,000 was applied to dredging some of the worst bars in the Grand River between Grand Rapids and its mouth, the result of which was to obtain, temporarily, narrow channels through these bars with a navigable depth of about 4 feet. In its original condition, the depth in crossings over some of the bars did not exceed 2 feet. No further work was done on the stream until 1896, when a project was adopted which provided for dredging a channel to the depth of 10 feet and width of 100 feet, the estimated cost being $670,500. Operations under this project were commenced in May, 1897, and from that time until June 30, 1897, 14,035 cubic yards of material had been dredged, and the expenditures to that date were $8,420.02, for fitting up the required plant and doing the dredging above indicated.

The total expenditures for improvement of this river to June 30, 1897, amounted to $58,420.02.

The expenditures during the past fiscal year were applied to continuing the work of dredging, the amount excavated during the year being 147,170 cubic yards, making the total excavation since the beginning of the work 161,205 cubic yards. The maximum available depths at the shoalest points of the dredged channels June 30, 1898, varied from 3 to 5 feet, except in that made through Deer Creek Bar, 19½ miles below Grand Rapids, where the depth was reduced to 2½ feet as a result of the spring freshets in the river.

July 1, 1897, balance unexpended	$41,579.98
June 30, 1898, amount expended during fiscal year	18,695.21
July 1, 1898, balance unexpended	22,884.77
July 1, 1898, outstanding liabilities	1,609.13
July 1, 1898, balance available	21,275.64
Amount (estimated) required for completion of existing project	620,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	100,000.00

(See Appendix K K 9.)

10. Muskegon Harbor, Michigan.—The first improvement at this place was made at local expense by constructing slab piers and revetments so as to afford entrance from Lake Michigan to Muskegon Lake for vessels drawing 7 feet. The work was taken in hand by the Government in 1867, old piers were remodeled and extended across the bar at entrance, channel dredged, and a through depth of 12 feet obtained. Thereafter the piers were prolonged as necessitated by the steady lakeward progress of the shore line and sand deposits in advance of it, and a fair 12-foot channel thereby maintained, but the clear way between the piers was only 180 feet, making entrance dangerous in stormy weather. After 1882 this difficulty was remedied by building extensions of the north pier on a line 300 feet from the south pier and connecting the old and new lines by an oblique wing of crib work 330 feet long. In 1892 the project of improvement was amplified and defined with a view to securing and maintaining a navigable depth of 15 feet. Its estimated cost was $260,000. Prior to the adoption of this modified project operations had been carried on under appropriations made from time to time in such sums as were called for to meet immediate necessities, but without defined estimates of ultimate cost. The expenditures for the work so done amounted to $262,914.18.

The total expenditure to June 30, 1897, was $430,341.90, when the north pier and revetment had a completed length of 2,579 feet and the south pier 1,485 feet.

The expenditures during the last fiscal year were applied to the construction of 200 linear feet of crib work for extending the south pier, repairing about 250 feet of old crib work of the same pier, and dredging. The maximum available depth at shoalest part of channel, June 30, 1898, was 15 feet.

July 1, 1897, balance unexpended		$33,658.10
June 30, 1898, amount expended during fiscal year		24,390.31
July 1, 1898, balance unexpended		9,267.79
July 1, 1898, outstanding liabilities	$155.32	
July 1, 1898, amount covered by uncompleted contracts	6,797.11	
		6,952.43
July 1, 1898, balance available		2,315.36

Amount (estimated) required for completion of existing project	125,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	60,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix K K 10.)

11. White Lake Harbor, Michigan.—The improvement at this point contemplates the creation and maintenance of a channel 200 feet wide and 12 feet deep between revetments and piers extending to deep water in Lake Michigan, thereby providing easy entrance to White Lake. Before improvement the two lakes were connected by a narrow and winding stream with a navigable capacity of only 5 feet. The estimated cost of the improvement was originally $170,530.80, subsequently increased by additional projects of 1873, 1884, and 1892 to $337,550.

The total expenditure to June 30, 1897, was $280,360.26, and the harbor works then comprised a north pier 1,515 feet long projecting into Lake Michigan 360 feet beyond its shore line, and a south pier 1,854 feet long projecting 700 feet beyond the shore line.

No work was done during the last fiscal year. The maximum available depth at shoalest part of channel June 30, 1898, was 10½ feet.

July 1, 1897, balance unexpended		$9,189.74
June 30, 1898, amount expended during fiscal year		243.82
July 1, 1898, balance unexpended		8,945.92
July 1, 1898, outstanding liabilities	$105.60	
July 1, 1898, amount covered by uncompleted contracts	2,000.00	
		2,105.60
July 1, 1898, balance available		6,840.32
Amount (estimated) required for completion of existing project		48,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, including maintenance		35,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix K K 11.)

12. Pentwater Harbor, Michigan.—Originally an unnavigable connection existed between Lake Michigan and Pentwater Lake, which had been improved by local interests so as to afford a narrow 4-foot channel at the time the Government work was commenced in 1867. The project of improvement then adopted and followed without modification until the present time aimed to increase the channel depth to 12 feet and maintain it between revetments and piers extending into Lake Michigan. Its estimated cost was $327,713.40.

The total expenditure to June 30, 1897, was $241,264.96, and the harbor work then comprised a north pier and revetment 2,226 feet long projecting into Lake Michigan 610 feet beyond the shore line, and a south pier and revetment 1,847 feet long projecting 621 feet beyond the shore line.

No work was done at the harbor during the last fiscal year until near its close, when operations for rebuilding about 440 feet in length of the north pier were commenced; but little progress had been made on this work up to the close of the year. The maximum available depth at the shoalest part of the channel June 30, 1898, was 10½ feet.

The present piers reach to but little beyond the 10-foot curve in Lake Michigan, and for this reason a greater navigable depth can not be kept, except as dredging serves to give it temporarily. Twelve feet, as called for by the approved project, can be obtained and held with any permanence only when the piers shall have been extended to the 15-foot curve, now 300 to 400 feet distant; the limit of extension at present authorized is 200 feet for the south and nothing for the north pier. Nearly 2,000 feet of the old pier work is over 20 years old and most of it so thoroughly dilapidated that entire reconstruction is urgently important.

July 1, 1897, balance unexpended		$7,555.04
June 30, 1898, amount expended during fiscal year		403.35
July 1, 1898, balance unexpended		7,151.69
July 1, 1898, outstanding liabilities	$708.57	
July 1, 1898, amount covered by uncompleted contracts	4,474.72	
		5,183.29
July 1, 1898, balance available		1,968.40
Amount (estimated) required for completion of existing project		78,893.40
Amount that can be profitably expended in fiscal year ending June 30, 1900		25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix K K 12.)

13. Ludington Harbor, Michigan.—Before the Government undertook any work for improving this harbor, local enterprise had made a narrow

7-foot channel from Lake Michigan to Pere Marquette Lake, and maintained it for several years. The Government work was commenced in 1867, with the purpose of enlarging the channel to a width of 200 feet and depth of 12 feet, and protecting it by piers projecting into Lake Michigan. The estimated cost was $270,682. The improvement was duly made, and subsequently maintained by periodical dredging and pier extensions. In 1890 the scope of the design was enlarged, and 18 feet was fixed upon as the depth to be obtained, thereby necessitating extensions of 500 and 700 feet to the north and south piers respectively. It was further designed that these extensions should be so made as to increase the width at entrance to 250 feet. These extensions have been so made, but the full depth of 18 feet has not yet been fully realized.

In 1890 the old project was modified, increasing the navigable depth to 18 feet and the width of channel at entrance to 250 feet. Under this modification the north and south piers were extended 500 and 700 feet respectively. At the beginning of the last fiscal year the total length of the north pier was 1,452 feet and it projected 880 feet beyond the shore line; the south pier had a total length of 2,381 feet and projected 1,435 feet beyond the shore line.

The total estimated cost of the original and modified projects was $381,682, and the amount expended to June 30, 1897, was $368,819.90, resulting in the construction and maintenance of the piers above referred to, and an extensive amount of dredging in the channel way between them. The expenditures for the past fiscal year were applied in rebuilding 207 linear feet of the north pier and 303 linear feet of the south pier. The maximum available depth at the shoalest part of the channel June 30, 1898, was 16½ feet.

A considerable portion of the old piers is badly rotted and rapidly falling to pieces; about 2,300 linear feet is more than 20 years old, and of this distance more than half is between 25 and 30 years old. It is essential that these portions be rebuilt as soon as practicable.

A special report in relation to this harbor dated January 2, 1897, was submitted to Congress in compliance with the provisions of the river and harbor act of June 3, 1896, and published as House Doc. No. 273, Fifty-fourth Congress, second session, and in Annual Report, Chief of Engineers for 1897, page 2951. The estimated total cost, as given in that report, of completing the improvement of the harbor so as to obtain and maintain a channel with a navigable depth of 18 feet, is $210,000.

July 1, 1897, balance unexpended		$19,614.20
June 30, 1898, amount expended during fiscal year		12,059.66
July 1, 1898, balance unexpended		7,554.54
July 1, 1898, outstanding liabilities	$854.55	
July 1, 1898, amount covered by uncompleted contracts	4,000.00	
		4,054.55
July 1, 1898, balance available		3,499.99
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		25,000.00

(See Appendix K K 13.)

14. Manistee Harbor, Michigan.—Before the Government undertook any work at this place, local enterprise had opened an entrance to the river for vessels drawing 7 feet. Systematic work was commenced by the Government in 1867, under a project for pier construction and dredging, with a view of forming and maintaining a navigable channel 12 feet deep at the entrance to and between the piers. The project was

extended in 1873 to include dredging in the river for a distance of about 1,350 feet inside the shore end of piers, and to constructing revetments along the line of channel so dredged. In 1890 the scope of operations was again extended to include dredging a channel 15 feet deep throughout the length of the Manistee River, a distance of about 8,000 feet, from Lake Michigan to Manistee Lake, and to extending the north and south piers, respectively, to the 18 and 14 foot curves in Lake Michigan, with a view to maintaining that depth of channel at the entrance. The river channel was dredged through in 1891-92, and the proposed extension of the north pier was completed in 1893. The south pier has not yet been extended.

The total estimated cost of all work, contemplated by the projects above referred to, was $408,000, and the total expenditure applied to their construction and maintenance to June 30, 1897, $360,001.82. The total length of piers constructed was 4,105 feet, and the available channel depth 13½ feet.

The amount expended during the last fiscal year was applied to dredging, the amount excavated being 11,664 cubic yards, which resulted in making a navigable channel depth of 15 feet temporarily. The maximum available depth at the shoalest part of the channel June 30, 1898, was 13 feet.

The 350-foot extention of the south pier, as contemplated by the present approved project, should be made without further delay, as the rapid development of the sand accretions at the present end of the pier is liable at any time to produce a complete blockade at the entrance to the harbor; 300 linear feet of crib work now over 20 years old needs rebuilding above water, and dredging is required annually for maintaining the necessary depth of channel between the piers and in the river above.

July 1, 1897, balance unexpended		$14,998.18
June 30, 1898, amount expended during fiscal year		1,856.50
July 1, 1898, balance unexpended		13,141.68
July 1, 1898, outstanding liabilities	$53.80	
July 1, 1898, amount covered by uncompleted contracts	3,000.00	
		3,053.80
July 1, 1898, balance available		10,087.88

Amount (estimated) required for completion of existing project	50,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, including maintenance	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix K K 14.)

15. Harbor of refuge at Portage Lake, Manistee County, Mich.—The great need of a harbor of refuge in this vicinity has long been recognized, and the peculiar adaptability of Portage Lake led to its selection for this purpose as far back as 1878. Congress made the first appropriation for the work in the following year, and it has been in progress since that time; but the amounts appropriated have been so small that it has thus far been impossible to obtain any useful results so far as the object in view is concerned. The total estimated cost of the improvement is $267,500.

The total expenditure to June 30, 1897, was $124,107.65. This resulted in building 2,812 feet of piers and revetments, their maintenance during a period of twenty years, and in doing a large amount of dredging from year to year in the channel way between piers. The amount expended

during the last fiscal year was applied to dredging 18,019 cubic yards of sand from the channel, rebuilding 612 linear feet of old south pier, and adding 2 feet to the height of superstructure over a length of 1,342 linear feet of north pier. The result was to restore most of the pier work to a serviceable condition and to obtain a narrow channel sufficient for the requirements of the small local commerce tributary to the harbor. The maximum available depth at the shoalest part of the channel June 30, 1898, was 11 feet.

The work done during the past two years has simply served to restore the piers to the condition in which they were more than ten years ago, except 787 linear feet of south pier, which must also be rebuilt. Unless the piers are now prolonged to deep water, the whole expenditure of nearly $150,000 heretofore made will have been useless as respects its essential purpose. The estimated total cost of doing this, including repairs that remain to be done to the old piers and dredging the channel way to its full depth, is $155,000, provided all the work be done under a single appropriation. The cost under small appropriations can not be estimated with any degree of accuracy, but it would largely exceed that above indicated.

July 1, 1897, balance unexpended		$26,392.35
June 30, 1898, amount expended during fiscal year		17,115.66
July 1, 1898, balance unexpended		9,276.69
July 1, 1898, outstanding liabilities	$2,115.38	
July 1, 1898, amount covered by uncompleted contracts	3,803.97	
		5,919.35
July 1, 1898, balance available		3,357.34

Amount (estimated) required for completion of existing project	160,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	75,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix K K 15.)

16. Frankfort Harbor, Michigan.—Before any work was done by the Government, Lake Aux Becs Scies (Frankfort) could be entered from Lake Michigan by a narrow and uncertain channel 3 or 4 feet deep. The project adopted on commencing improvements in 1867 was to dredge a new connecting channel 12 feet deep and 200 feet wide, and to protect its sides by pile revetments and its entrance by crib piers extending 672 feet into Lake Michigan on the north side and 832 feet on the south side. The estimated cost was $146,400. This project was afterwards modified from time to time to provide for repairs, dredging, and necessary pier extension, until, in the project as adopted in 1892, the original estimate had been increased to $325,659.85 as the total estimated cost of original construction, maintenance, and repairs, and new work. The river and harbor act of June 3, 1896, provides for a navigable channel 18 feet deep.

The total expenditure to June 30, 1897, was $324,348.53, and the north pier then had a length of 1,499 feet and the south pier 1,537 feet, 400 of which had just been built by the Toledo and Ann Arbor Railway Company, without expense to the Government, in order to expedite work under the new project.

The expenditures during the past fiscal year were applied to rebuilding unserviceable sections of the old piers, aggregating 966 feet in length, and making some minor repairs to other portions. The maximum available depth at the shoalest part of the channel June 30, 1898,

was scant 16 feet, and the width of channel with that depth was less than 60 feet.

An extension of 600 feet to the north pier, supplementing that made by the railway company to the south pier, is essential for completing the improvement so as to provide and maintain the navigable depth of 18 feet called for by the river and harbor act of June 3, 1896, and urgently needed for the commerce of this port. The cost of this extension is estimated at $65,000, and this, with the cost of rebuilding unserviceable sections of old piers aggregating 650 feet in length, and dredging, makes the total amount required for completing the present approved project $75,000.

July 1, 1897, balance unexpended		$18,589.82
June 30, 1898, amount expended during fiscal year		9,065.57
July 1, 1898, balance unexpended		9,524.25
July 1, 1898, outstanding liabilities	$36.00	
July 1, 1898, amount covered by uncompleted contracts	5,846.98	
		5,882.98
July 1, 1898, balance available		3,641.27

Amount (estimated) required for completion of existing project	65,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900, including maintenance	45,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix K K 16.)

17. Charlevoix Harbor, Michigan.—The improvements at this place are designed to furnish access to Round and Pine lakes, situated in the northern part of the peninsula between Grand and Little Traverse bays. The original outlet from these lakes to Lake Michigan was a narrow stream through which boats drawing only 2 or 3 feet could pass, but local enterprise improved these conditions by dredging and temporary pier construction so as to permit the passage of vessels drawing 6 feet. Work was then commenced by the Government with an appropriation of $10,000, made in the river and harbor act of August 14, 1876, the project providing for dredging a straight channel 100 feet wide to a depth of 12 feet through Pine River to Round Lake, and protecting its sides by pile revetments and its entrance by crib piers 150 feet apart, extending to 12 feet of water in Lake Michigan. This project was extended in 1882 to provide a revetted channel 12 feet deep from Round to Pine Lake, and with this modification the estimated cost of the whole improvement was $186,000.

The structures built since the improvement was commenced comprise 2,484 linear feet of pile revetment and 1,271 feet of crib piers in the lower channel from Lake Michigan to Round Lake, and 705 feet of pile revetments in the upper channel which forms the connection between Round and Pine lakes, making the total length of piers and revetments 4,460 feet. All this work, together with a vast amount of dredging, was completed by 1890, and everything done from that time to the beginning of the last fiscal year was for maintaining the improvement, by miscellaneous repairs of piers and revetments, and dredging.

The total expenditure for original improvements and their maintenance to June 30, 1897, covering operations through a period of twenty-one years, was $118,693.70.

Operations during the last fiscal year were in continuation of work in progress at its commencement, under a contract completed in Decem-

ber, 1897, for rebuilding 478 linear feet of the old north pier which could no longer be trusted to hold together. Another contract was made in April, 1898, for rebuilding above water 723 linear feet of the revetment on the south side of the lower channel, and work was well under way at the close of the fiscal year.

A special report in relation to this harbor was submitted December 19, 1896, and is printed in Report of the Chief of Engineers for 1897, pages 2953–2954, and also as House Doc. No. 144, Fifty-fourth Congress, second session. It was made under the requirement of the river and harbor act of June 3, 1896, calling for the estimated cost of providing a navigable depth of 16 feet; the estimate submitted was $160,000.

If the old project contemplating a navigable depth of only 12 feet be adhered to, the estimated cost of completion and maintenance is as follows: Extending south pier 200 feet, $18,000; rebuilding 1,000 feet of old piers, $10,000; dredging, $4,000; making in all, with due allowance for supervision, engineering, and office contingencies, $35,000.

July 1, 1897, balance unexpended		$21,806.30
June 30, 1898, amount expended during fiscal year		8,646.38
July 1, 1898, balance unexpended		13,159.92
July 1, 1898, outstanding liabilities	$2,310.81	
July 1, 1898, amount covered by uncompleted contracts	5,610.78	
		7,921.59
July 1, 1898, balance available		5,238.33
Amount (estimated) required for completion of existing project		45,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900		25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

(See Appendix K K 17.)

18. Petoskey Harbor, Michigan.—Petoskey is so situated on the southeast shore of Little Traverse Bay that its water front is wholly exposed to winds coming from between west and northwest, and when high gales, with a sweep of more than 100 miles across Lake Michigan, blow from that quarter, it is impossible, or at least hazardous, to make a landing in the immediate vicinity. To remedy this condition of affairs Congress, by the river and harbor act of August 18, 1894, authorized the construction of breakwaters designed to cover the landing pier and provide a small sheltered area adjoining them. The estimated cost of the project was $170,000.

The total expenditure to June 30, 1897, was $50,496.12, resulting in the construction of 801 linear feet of breakwater. The expenditures during the last fiscal year were for repairing some damage that had been sustained by the slighter inshore sections of the breakwater.

July 1, 1897, balance unexpended	$2,503.88
June 30, 1898, amount expended during fiscal year	1,235.19
July 1, 1898, balance unexpended	1,268.69
July 1, 1898, outstanding liabilities	24.00
July 1, 1898, balance available	1,244.69
Amount (estimated) required for completion of existing project	117,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix K K 18.)

SURVEY MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The survey of *Kalamazoo River, Michigan, from Saugatuck to New Richmond*, was made by Capt. C. McD. Townsend, Corps of Engineers, and report dated December 28, 1897, submitted.

Four projects for improvement are presented, as follows:

1. For a channel with a depth of 4 feet at low water and bottom width of 50 feet	$5,000
2. For a channel with a depth of 6 feet at low water and bottom width of 75 feet	50,000
3. For a channel with a depth of 8 feet at low water and bottom width of 100 feet	100,000
4. For an 8-foot channel extending through Indian Channel and abandoning the main river from head of Indian Cut to Indian Point	78,000

Captain Townsend estimates that the channel dredged could be maintained at an annual cost not exceeding 10 per cent of the original outlay.

The report was transmitted to Congress and printed in House Doc. No. 233, Fifty-fifth Congress, second session. (See also Appendix K K 19.)

IMPROVEMENT OF RIVERS AND HARBORS ON THE EASTERN COAST OF MICHIGAN AND OF WATERS CONNECTING THE GREAT LAKES.

This district was in the charge of Lieut. Col. G. J. Lydecker, Corps of Engineers, having under his immediate orders Lieut. James F. McIndoe, Corps of Engineers, to April 10, 1898.

1. *Ship channel connecting waters of the Great Lakes between Chicago, Duluth, and Buffalo.*—When this project was adopted the available depth in the connecting waters of the Great Lakes was about 16 feet, a condition that had been brought about, in part, by successive improvements of several localities where the original depth had been from 6 to 10 or 12 feet only. In the meantime, and pursuant to Congressional legislation, projects had been inaugurated for obtaining a navigable depth of 20 feet through the St. Marys Falls Canal, Hay Lake Channel of St. Marys River, and Limekiln Crossing in Detroit River. To supplement this work and provide a channel of like navigable depth through other shoal places in the line of lake travel from the head of Lake Superior or Lake Michigan to Buffalo, at the foot of Lake Erie, the river and harbor act of July 13, 1892, provided as follows:

> For ship channel twenty and twenty-one feet in depth, and a minimum width of three hundred feet, in the shallows of the connecting waters of the Great Lakes between Chicago, Duluth, and Buffalo, three hundred and seventy-five thousand dollars: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary to carry out the plans proposed by General O. M. Poe, Corps of Engineers, United States Army, dated January twentieth, eighteen hundred and ninety-one, and printed as House Executive Document, Numbered Two hundred and seven, second session, Fifty-first Congress, for such ship channel, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate two million nine hundred and sixty-five thousand dollars, exclusive of the amount herein appropriated.

The estimated total cost of work specified in the foregoing paragraph was $3,340,000.

Operations were commenced in the spring of 1893 under contracts entered into December 31, 1892, and by June 30, 1897, channels of the prescribed depth had been completed with widths varying from 300 to 2,400 feet at all places specified in the original project.

The expenditure to June 30, 1897, was $2,212,512.35, with results as above indicated, the total excavation to that date being 9,643,179.78 cubic yards.

Operations during the last fiscal year comprise (1) work for increasing the width and depth of channels as originally completed through Round Island Shoals, St. Marys River, this being essential to make navigation through these channels reasonably safe on account of their exposure to heavy seas rolling in from Lake Superior, and the prevalence of fogs in the spring and fall months; (2) completing the removal of Point Aux Frênes Shoal, foot of Mud Lake, St. Marys River, thereby clearing the direct lines of travel of a dangerous obstruction, of which there was no knowledge when the original project was submitted; (3) removing part of the Middle Ground Shoal at Port Huron, St. Clair River, thereby widening and straightening the main ship channel and making navigation very much safer; (4) removing bowlders, rock, and other material from the ship channel in lower sections of the Detroit River, which now constitute the only link in the line of through travel at which the required depth of 20 feet has not yet been obtained. The result of the year's work there was to increase the available depth from 16½ feet to 18 feet at the present stage of water; (5) completing channel through bar at mouth of Detroit River (section 8 of the ship channel). This work was in progress from the spring of 1893 until October 29, 1897, under contract dated December 31, 1892, calling for dredging a channel 21 feet deep and 800 feet wide for a distance of about 26,500 feet. The total amount of material removed during the progress of the work was 1,093,916 cubic yards, scow measure, of which 82,793 cubic yards was taken out during the last fiscal year. Work done under items 2, 3, and 5 was completed, and that under 1 and 4 is still in progress.

The sundry civil act approved June 4, 1897, appropriated $1,090,000 "for completing improvement of channel connecting the waters of the Great Lakes between Chicago, Duluth, and Buffalo, including necessary observations and investigations in connection with the preservation of such channel depth."

This makes the total of appropriation equal to original estimate of cost, and it will suffice for doing all that was contemplated by that estimate; but the estimate was predicated on such general information as was available at the time, no specific surveys having then been made, and the development of shoals or dangers then unknown or not considered in the estimate, was indicated as being highly probable. It is now certain that additional funds will be required for the proper completion of this important commercial highway, not only to provide for the prompt removal of such shoals as soon as they may be discovered, but also to widen all the narrower portions of the through channel in order to make navigation through them reasonably safe; but the submission of any additional estimate for these purposes is deferred until called for by Congress.

The amount of freight carried through the St. Marys River section of this channel during the navigable season of 1897 was 18,982,755 tons, valued at $218,235,927. Reliable statistics of traffic through the Detroit River are not obtainable, but it is estimated that the amount and value of freight passing that section of the through channel are at least double those of the St. Marys River section.

July 1, 1897, balance unexpended		$1,130,265.71
June 30, 1898, amount expended during fiscal year, including 48 cents paid by Treasury Department, account Western Union Telegraph Company		294,609.05
July 1, 1898, balance unexpended		835,656.66
July 1, 1898, outstanding liabilities	$35,481.81	
July 1, 1898, amount covered by uncompleted contracts	193,073.50	
		228,555.31
July 1, 1898, balance available		607,101.35

(See Appendix L L 1.)

2. St. Marys River at the falls, Michigan.—When the present project of improvement was adopted the maximum draft which vessels could carry through the canal and locks at Sault Ste. Marie, Mich., was 16 feet. The old State Lock of 1855 was 700 feet long between gates and 70 feet wide, with 11½ feet of water over miter sills. The United States Lock of 1881, now known as the Weitzel Lock, was 515 feet long between gates and 80 feet wide, with 17 feet depth over miter sills.

Immediately after the Weitzel Lock was opened to traffic an astonishing increase in commerce took place; a like increase in the size of the vessels engaged in it followed, and a corresponding increase of navigable depth and locking capacity became imperative. The project of October 18, 1886, was promptly adopted to meet these requirements, its leading features being to construct at the site of the old State Lock a new lock 800 feet long between gates, 100 feet wide, with a depth of 21 feet over miter sills, and to provide it with the best possible operating machinery for the rapid passage of commerce, the canal and its approaches to be enlarged and deepened correspondingly. The estimated cost of the projected work was $4,738,865. Details of project and estimate are published in the Annual Report of the Chief of Engineers for 1887, pp. 2220 to 2223.

Work was commenced in 1887 and is still in progress. Until 1890 it was prosecuted under successive appropriations, but the river and harbor act of September 19, 1890, provided for its completion under the continuing-contract system, and the appropriation made by the sundry civil act of March 2, 1895, brought the aggregate of appropriations up to the amount called for by the original estimate.

The amount expended to June 30, 1897, was $3,561,991.12. The principal features of the projected improvement had then been completed; the new lock, called the Poe Lock in honor of its projector, was in service, having been opened to navigation August 3, 1896; and the canal had been deepened throughout to 25 feet, except at the site of the old movable dam, the miter sill of which was still in place with a depth of only 16½ to 17 feet at the stage of water then prevailing. The expenditures during the last fiscal year were applied to continuing excavation of the approaches to the canal, to the removal of the sill of the old movable dam, the erection of new safety gates for replacing it, and to surveys and examinations for further operations.

No additional estimate is submitted, as the balance of previous appropriations will suffice for all work required to complete what remains to be done of the projected improvement.

The commerce passing the falls of St. Marys River during the navigation season of 1897, a period of 238 days, comprised 18,982,755 tons of freight, valued at $218,235,927.77. The number of passengers reported on vessels for the same period was 40,213.

July 1, 1897, balance unexpended		$1,201,913.44
June 30, 1898, amount expended during fiscal year, including 20 cents paid by Treasury Department, account Western Union Telegraph Company		141,707.74
July 1, 1898, balance unexpended		1,060,205.70
July 1, 1898, outstanding liabilities	$49,366.96	
July 1, 1898, amount covered by uncompleted contracts	28,645.84	
		78,012.80
July 1, 1898, balance available		982,192.90

(See Appendix L L 2.)

3. Operating and care of St. Marys Falls Canal, Michigan.—The canal was opened to navigation two hundred and thirty-seven days, the closed season being from December 10, 1897, to April 18, 1898. The Poe and Weitzel locks were both in service. A total of 13,411 vessels, aggregating 14,435,068 registered tons and carrying 14,968,377 tons of freight and 28,767 passengers, passed through the locks in 9,222 lockages. The Canadian Canal at Sault Ste. Marie, Ontario, passed 4,750 vessels, carrying 5,320,262 tons of freight and 11,883 passengers, making the combined traffic through the two canals 20,288,639 tons of freight and 40,650 passengers, being 4,471,062 tons and 6,631 passengers in excess of any previous record, showing a phenomenal increase of 27 and 38 per cent, respectively, in this Lake Superior commerce for the last fiscal year.

The principal items of freight carried were: Iron ore, 11,789,353 tons; coal, 3,333,075 tons; flour, 8,449,352 barrels; wheat, 47,926,776 bushels; other grain, 22,907,132 bushels, and lumber, 808,607,000 feet, board measure.

The total expenditure for the operation and care of the canal during the year was $58,890.72.

(See Appendix L L 3.)

4. Hay Lake Channel, St. Marys River, Michigan.—Before improvement navigation via Hay Lake was impossible for commercial purposes, on account of rapids and shoals at the head and foot of the lake. The original project of improvement, October 27, 1882, contemplated a channel 300 feet wide and 17 feet deep through the obstructed sections, so as to pass from the then navigable channel of the St. Marys River into Hay Lake at the head of Sugar Island, and then, by way of the Middle Neebish, to rejoin the navigable channel of the river at the foot of Sugar Island, thus saving a distance of 11 miles and obtaining a safe route for travel by night, which was not practicable by the old channel. The estimated cost of this project was $2,127,292. The project was modified in 1886 to increase the navigable depth to 20 feet, and in 1896 to make the channel wider at angles and other critical points. The estimated cost of the modified project of 1886 was $2,659,115.

The work of improvement was commenced in 1883, and the route opened to commerce June 7, 1894, though the full width of channel had not then been completed at all points. Operations since then have been directed toward obtaining the width requisite for safe navigation.

The amount expended to the close of the fiscal year ending June 30, 1897, was $1,941,018.37.

The improved channel was excavated to a depth of 20 feet below the assumed mean water surface where the bottom was in soft material, and 21 feet in rock or other hard bottom, except for a length of about

2,500 feet of rock cutting in the Middle Neebish, where a depth of only 20 feet was made. The first work done on the improvement covered this section of the Neebish, and the depth of excavation there was referred to a higher water surface than that subsequently assumed for the other sections. The result is that the safe navigable depth in this section was approximately 2 feet less than in other parts of the improvement.

The result of this improvement is that practically all commerce of the St. Marys River now passes by this route, as only rafts and a few small vessels engaged in local traffic continue to follow the old channel; the distance from the mouth of the St. Marys River to the canal at Sault Ste. Marie is shortened 11 miles, or 19 per cent, and night navigation of the entire route is now safe, whereas it was impracticable before. The amount of freight passing through this improved channel during the season of 1896 (two hundred and thirty-two days) was 16,239,061 tons, valued at $195,146,842, and during the season of 1897 (two hundred and thirty-eight days) it was 18,982,755 tons, valued at $218,235,927.

During the last fiscal year several isolated shoals on or near the line of travel were removed and the width of channel increased at angular points or other places where special danger had been found to exist. The result has been to make navigation much safer at those places. Work for deepening the Middle Neebish section to the same grade as the rest of the improvement has been in progress since September 15, 1897, and will probably be finished during the ensuing fiscal year. In the meantime navigation in that locality is a dangerous affair, because the width left open to traffic while work is going on will be from 150 to 200 feet only.

The maximum available depth at the shoalest part of the channel June 30, 1898, was 18 feet. This was in the Middle Neebish section, which is now being deepened, all other parts of the improvement having a depth of 20 feet or more.

When the work now in progress of deepening the Middle Neebish section to the grade of the other parts of the Hay Lake Channel is completed, the full depth called for by the approved project will have been obtained throughout; but about 10 miles of the navigable route will still be only 300 feet wide, and this is not a safe width for the character and amount of traffic passing through these channels. Through commerce is increasing so rapidly that measures should be taken without delay for completing the improvement so that vessels bound in opposite directions will not be required to meet in channels less than 600 feet wide. This may be accomplished by increasing the width of existing channels, but a far better plan, in my judgment, would be to open another route from Hay Lake to Mud Lake via the West Neebish, thereby providing separate channels for upbound and down-bound craft.

The unappropriated balance of the original estimate for this improvement will not suffice for completing the work by either course outlined above, but will probably be enough to complete that now in progress on the Middle Neebish and do a small amount of widening at a few other critical points. In the absence of any call by Congress for more extended work, the estimate herewith submitted is limited to the amount of that balance, viz, $494,115.

July 1, 1897, balance unexpended		$224,124.10
June 30, 1898, amount expended during fiscal year		96,421.89
July 1, 1898, balance unexpended		127,702.21
July 1, 1898, outstanding liabilities	$13,815.51	
July 1, 1898, amount covered by uncompleted contracts	113,005.82	
		126,821.33
July 1, 1898, balance available		880.88

Amount (estimated) required for completion of existing project	494,115.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix L L 4.)

5. *Cheboygan Harbor, Michigan.*—The present harbor is the result of improvements made at the mouth of Cheboygan Harbor since 1871, when the available depth of water was only 6 feet. The original project called for a channel 200 feet wide and 14 feet deep, and the estimated cost of the whole work was $395,335. The project was modified in 1880 to increase the depth to 15 feet. These projects were duly carried out, the last named being completed in 1889, when the 15-foot channel had been dredged to 200 feet wide from deep water in the Straits of Mackinac to the State Road Bridge, a distance of about 1⅓ miles. A 40-foot square crib was built in 1881 to mark the entrance to the channel, and a light-house was subsequently placed on it by the United States Light-House Establishment.

The channel was redredged in 1895 to a width of 110 feet, and since then no work has been done.

The total expenditure to June 30, 1897, was $147,999.49, and the available channel depth at that date was 14 feet.

The expenditure during the last fiscal year, amounting to $255, was applied to office and engineering contingencies; these included an examination of the harbor June 23, 1898, which indicates that considerable shoaling has taken place during the year, especially in the upper portion, where quite a number of soundings showed a depth of 12 feet in mid-channel, and in several instances only 11½ feet.

Under the provisions of the river and harbor act of August 18, 1894, an estimate for increasing the navigable depth to 18 feet was submitted, and the act of June 3, 1896, appropriated $12,000 for this purpose. The total estimated cost of the project was $33,000, and it will not be expedient to enter upon it until the means available will suffice for dredging the entire length of channel to the prescribed depth for a width of at least 125 feet.

The following statement indicates the commerce of this harbor during the past five calendar years, as shown by data compiled from the most reliable information available:

Year.	Number of vessels.	Freight tonnage.	Year.	Number of vessels.	Freight tonnage.
1893	940	441,087	1896	1,040	525,373
1894	1,033	303,900	1897	1,216	340,332
1895	1,249	326,930			

July 1, 1897, balance unexpended	$12,000.51
June 30, 1898, amount expended during fiscal year	255.00
July 1, 1898, balance unexpended	11,745.51

Amount (estimated) required for completion of existing project	21,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix L L 5.)

6. *Alpena Harbor (Thunder Bay River), Michigan.*—The city of Alpena occupies both banks of Thunder Bay River at its mouth, and this reach of river, about a mile long, together with the dredged channel through the bar in advance of it, constitutes Alpena Harbor, and it has been the subject of improvements heretofore carried on by the Government under appropriations for improving Thunder Bay Harbor and Thunder Bay River.

The original depth at entrance to the river was only 7 feet, but local enterprise increased it to 12 feet. The work of improvement by the Government has provided a wider channel and increased the depth to 13, 14, and 16 feet, under successive projects, whose costs were estimated as $1,764, $15,000, and $36,087, respectively, the total of the three separate estimates being $55,851. The proposed work was completed in 1893, and nothing has been done since then.

The total amount expended to June 30, 1897, was $41,697.28.

The expenditure for the last fiscal year, amounting to $255, was applied to engineering and office contingencies; these included an examination of the harbor in the summer of 1897, when the available channel depth was found to be 12½ feet, a reduction of 3½ feet since the harbor was last dredged, in 1893. Funds on hand will suffice to redredge the channel to the depth of 16 feet called for by the present approved project, and therefore no additional estimate is now submitted.

The following statement indicates the commerce of this harbor during the past five calendar years, as shown by data compiled from the most reliable information available:

Year.	Number of vessels.	Freight tonnage.	Year.	Number of vessels.	Freight tonnage.
1893	940	360,588	1896	1,040	349,754
1894	1,033	465,991	1897	1,245	353,982
1895	1,249	305,160			

July 1, 1897, balance unexpended	$9,802.72
June 30, 1898, amount expended during fiscal year	255.00
July 1, 1898, balance unexpended	9,547.72

(See Appendix L L 6.)

7. *Saginaw River, Michigan.*—Before improvement the navigable capacity of this stream was limited by the bar at its mouth, where a channel depth of 8 feet only was available, and by many shoal stretches in the river between there and the city of Saginaw, over which still less depth was to be found. Its improvement was commenced in 1867 by dredging a straight cut through the bar at the mouth to a depth of 13 feet, the work being completed in the following years. In subsequent years the scope of operations was gradually extended to various shoals higher up, but subject to no general project until 1882, when a comprehensive and connected scheme of improvement covering the entire river

was proposed and adopted. It called for a navigable channel 14 feet deep and 200 feet wide from Saginaw Bay to the upper limits of Bay City, about 8 miles above the point of beginning, and thence to the head of navigation, some 16 miles farther up, a channel of the same width, but only 12 feet deep. The estimated cost of this project was $446,000, which, added to the estimated cost of the several preceding projects ($294,378), gives $740,378 as the estimate of cost for the whole improvement. These estimates concerned the question of original cost only, and took no note of maintenance, which, in a stream of this character, is a matter of great and constant expense, and in the absence of appropriations specifically applicable thereto must be an annual tax of no small magnitude on the successive appropriations for construction. The sum total of appropriations that will have to be made before the work can be completed must therefore largely exceed the original estimates for construction only.

The total expenditure to June 30, 1897, was $709,117.27, and the result obtained was a through channel, with depths as proposed from the bay to near the head of navigation, but the widths of dredged channels were, as a rule, only from one quarter to one-half what was called for by the approved project; frequent redredgings have been required to maintain the necessary channel depth.

No work was in progress during the last fiscal year except to complete certain maps and reports called for by the river and harbor act of June 3, 1896.

The reports were completed and forwarded November 22, 1897, and are printed as House Doc. No. 135, Fifty-fifth Congress, second session, and as Appendix L L 20 of this report.

July 1, 1897, balance unexpended	$38,632.73
June 30, 1898, amount expended during fiscal year	697.62
July 1, 1898, balance unexpended	37,935.11
July 1, 1898, outstanding liabilities	10.00
July 1, 1898, balance available	37,925.11
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	25,000.00

(See Appendix L L 7.)

8. Sebewaing River, Michigan.—This stream discharges into the eastern part of Saginaw Bay.

In 1875 the river channel was straightened and deepened to 6 feet and a narrow channel 6 feet deep dredged from the mouth to the 6-foot contour in the bay. In 1880-81 the channels previously dredged were deepened by about 1 foot.

Total expenditure in these operations, $15,000.

The present project for improvement, adopted by the river and harbor act of June 3, 1896, provides for dredging the entrance channel for a length of about 15,000 feet to a width of 100 feet and depth of 8 feet below the datum plane of the survey of 1895. The estimated cost of this work is, in round numbers, $37,000.

The appropriation made by the act of June 3, 1896, was $5,000, but no work has yet been done, as it is believed that no useful result can be obtained by an expenditure of so small a sum. The nature of the proposed improvement and the exposure to which the plant engaged on the work must be subjected until most of it is accomplished, make it of peculiar importance that the entire estimated cost be appropriated

before any work whatever is commenced. In no other way can any improvement commensurate with the cost of operations be effected.

July 1, 1897, balance unexpended	$5,000.00
July 1, 1898, balance unexpended	5,000.00
Amount (estimated) required for completion of existing project	32,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	16,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix L L 8.)

9. *Harbor of refuge at Sand Beach, Lake Huron, Michigan.*—The site for this harbor, selected in 1872 after careful consideration, is on the west shore of Lake Huron, 60 miles north of its outlet into the St. Clair River, and the artificial harbor built there since then is the only safe refuge on that coast from the foot of the lake to Tawas Bay, 115 miles above. The work of construction was commenced in 1873, under a project providing for three sections of breakwater, made of stone-filled crib work, so located as to shelter a water area of some 650 acres and for deepening this area by dredging where necessary. The estimated cost was $1,442,500. The sheltering breakwaters, with a total length of 8,132 feet, were completed in 1885 at a cost of about $975,000, and since that time expenditures have been applied to keeping them in repair, dredging, and supervising the berthing of vessels entering the harbor for refuge. The total expenditure to June 30, 1897, was $1,196,304.86. The amount expended during the last fiscal year was $5,045.43, and it was applied to supervising the use of the harbor and to minor repairs of its breakwaters.

As respects the benefits to the general commerce on the Great Lakes, this harbor is second in importance to no other, but its local commercial interests are small. The number of vessels that took refuge at the harbor during the past fiscal year was 1,114, with a total tonnage of 408,392.49. The grand total of vessels entering for shelter during the calendar years 1877 to 1897, inclusive, is 25,007, the tonnage of which aggregated 8,336,669. The size of vessels sheltered in 1877 averaged 289 tons, and in 1897 this average had increased to 398 tons.

The timber superstructure of the main breakwater, which is nearly a mile long, is in such an advanced state of decay that it is likely to be carried away by any heavy storm in the near future, and when this occurs the utility of the harbor will be destroyed to a corresponding extent. It is not safe to longer postpone provision for rebuilding the superstructure of this breakwater, and when rebuilt it should be of masonry.

July 1, 1897, balance unexpended	$109,695.14
September 4, 1897, amount collected on account of damage to piers and deposited to the credit of the appropriation	107.05
	109,802.19
June 30, 1898, amount expended during fiscal year	5,045.43
July 1, 1898, balance unexpended	104,756.76
July 1, 1898, outstanding liabilities	223.47
July 1, 1898, balance available	104,533.29
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix L L 9.)

10. Mouth of Black River, Michigan.—An extensive shoal and a bar formerly existed in the St. Clair River, adjoining the mouth of the Black. The bar lay close to the American side and obstructed approach to the Port Huron docks, while the shoal, forming a "middle ground" nearly 50 acres in extent, crowded the main channel in a sharp curve close to the Canadian shore, thereby exposing the vast through commerce of the lakes to the dangers attendant upon passing a narrow and crooked channel with a current of high velocity. In 1871 a project was adopted for dredging the bar and middle ground to a uniform depth of 15 feet by excavating 257,200 cubic yards, at an estimated cost of $120,660. The work was commenced in 1872 and completed in 1878. A slight shoaling took place in the years following, and the whole area was redredged between 1889 and 1892, the depth of excavation this time being 16 feet, except over a strip bordering the main channel, where it was increased to 18 feet. The total expenditure to June 30, 1897, was $86,928.73.

The expenditure during the last fiscal year was applied to redredging the shoal, the work being completed November 30, 1897, the total amount excavated being 46,458 cubic yards. The result was to restore the general navigable depth of 16 feet over the shoal area.

Experience shows that the shoal will re-form in the near future, and as the whole commerce between the upper and lower lakes passes over this area, or in the deep-water channel adjoining it, it is a matter of vast importance that means be at hand to prevent such extensive shoaling as will materially interfere with this commerce.

July 1, 1897, balance unexpended	$7,571.27
June 30, 1898, amount expended during fiscal year	5,440.73
July 1, 1898, balance unexpended	2,130.54
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	7,000.00

(See Appendix L L 10.)

11. Black River at Port Huron, Mich.—This stream passes through the city of Port Huron, Mich., and empties into the St. Clair River. Before improvement it had a general channel depth of not less than 10 feet, reduced to 8½ feet at several shoals. The river and harbor act of September 19, 1890, appropriated $25,000 for dredging the channel to a depth of 16 feet. Work was commenced in the year following, and continued until August, 1892, when 184,989 cubic yards had been dredged, resulting in a channel 16 feet deep, 150 feet wide, from the mouth to the Flint and Pere Marquette Railway Bridge, 600 feet above, thence 100 feet wide to Haynes's lumber dock, 4,700 feet farther up, and thence 50 feet wide for the remaining distance of 3,000 feet to the Grand Trunk Railway Bridge. The next river and harbor act appropriated $10,000 for continuing the work, and directed that it be extended to Washington avenue, 1,400 feet above the Grand Trunk Bridge. This served for excavating 46,630 cubic yards during the summer of 1893, thereby widening the 50-foot section of channel previously dredged below the bridge to a width of 75 feet, and making a channel 50 feet wide up to Washington avenue. The total length of channel originally dredged to a depth of 16 feet is 9,700 feet.

The estimated cost of completing the improvement as projected under the river and harbor act of 1890 was $75,000, and the amount expended

under that project, and the extension called for by the river and harbor act of July 13, 1892, to June 30, 1897, was $35,234.99.

The expenditure during the last fiscal year was applied to redredging 9,100 linear feet of the river channel to a depth of 16 feet and widths varying from 25 to 100 feet, the total amount excavated being 70,049 cubic yards. The channel has not been examined since the work was completed, but recent reports from there indicate that a considerable portion of the recently dredged channel has refilled to such an extent that the depth has become reduced to 10 feet or less in some places.

The above and frequent like previous experiences show conclusively that these narrow dredged channels can have but little permanence until the river banks be properly docked or revetted.

The following statement indicates the commerce of this river during the past five calendar years, as shown by data compiled from the most reliable information available:

Year.	Number of vessels.	Freight tonnage.	Year.	Number of vessels.	Freight tonnage.
1893	602	182,568	1896	628	189,556
1894	595	120,948	1897	645	98,380
1895	587	111,675			

July 1, 1897, balance unexpended	$7,765.01
June 30, 1898, amount expended during fiscal year, including $2.84 paid by Treasury Department account Grand Trunk Railway system	6,449.11
July 1, 1898, balance unexpended	1,315.90
Amount (estimated) required for completion of existing project	32,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix L L 11.)

12. Pine River, Michigan.—This river was improved in 1875 by dredging a channel 100 feet wide, 12 feet deep, for a distance of about three-fourths of a mile upstream from the mouth of the river. The cost was $5,000. This channel shoaled up in time, and after an examination of the river, called for by the river and harbor act of July 13, 1892, a project for further improvement was prepared under the act of August 18, 1894, and the act of June 3, 1896, appropriated $5,000 for commencing the work. This project provides for dredging a channel 14 feet deep, extending about 5,800 feet from the mouth, the width to be 100 feet or 75 feet, according to locality. The estimated cost was $10,560.

Work on the new project was commenced September 24 and continued until November 16, 1896, resulting in a channel of the prescribed width and depth for a distance of 2,500 feet from the mouth, and with a width of 30 feet over the remainder of the proposed distance.

The amount expended on this project to June 30, 1897, was $4,452.95, and no work has been done since that time. The total amount expended for the improvement of the river to that date was $9,452.95.

The appropriation of $5,560 will be required to complete the improvement.

The commerce of this river during the past two calendar years, from the best information obtainable, amounted to 2,683 freight tons for 1896 and 6,820 freight tons for 1897, the total for the two years being 9,503 freight tons.

July 1, 1897, balance unexpended	$547.05
June 30, 1898, amount expended during fiscal year	9.00
July 1, 1898, balance unexpended	538.05
Amount (estimated) required for completion of existing project	5,560.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	5,560.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix L L 12.)

13. Belle River, Michigan.—This river was improved, 1880–1885, by dredging a channel 50 feet wide, 13 feet deep to the first bridge and 12 feet to the second one, a total distance of 5,400 feet. The total cost was $14,000, and the principal benefit was to provide a winter harbor for vessels.

The river and harbor act of July 13, 1892, called for an examination of the river, and that of August 18, 1894, for survey and estimate of cost of its further improvement. Project for redredging the channel to a width of 75 feet and depth of 15 feet to the first and 14 feet to the second bridge was submitted November 30, 1895, the estimated cost being $21,500; the act of June 3, 1896, appropriated $5,000 for beginning the work, and the amount expended under this project to June 30, 1897, was $322.72.

The total amount expended for improvement of this river to June 30, 1897, was $14,322.72.

Operations during the last fiscal year consisted of dredging in continuation of the work. The total amount of excavation was 39,035 cubic yards, of which 24,949 was removed during the fiscal year. The result was to provide a channel 15 feet deep and about 75 feet wide, extending from the mouth of the river for a distance of about 2,400 feet upstream. The completion of the improvement as projected will require an additional appropriation of $10,000.

The commerce of this river during the past calendar year, as shown by the best obtainable data, amounted to 52 entrances and clearances, with a freight tonnage of 11,396.

July 1, 1897, balance unexpended	$4,677.28
June 30, 1898, amount expended during fiscal year	4,605.38
July 1, 1898, balance unexpended	71.90
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix L L 13.)

14. St. Clair Flats Canal, Michigan.—The original condition of the channel before any improvement was commenced afforded only about 6 feet of water over the bar at the mouth of the South Pass.

The project for the improvement of the canal, as modified from time to time, provided for a double row of sheet piling to a depth of 26 feet along the channel face of each dike, dredging the area between the dikes to a depth of 20 feet, and continuing the channel above and below the canal to that depth of water in river and lake.

The total amount appropriated for this improvement from its beginning in 1866 until 1890 was $764,810, and the total expenditure to June 30, 1897, was $760,223.46.

No operations were in progress under this appropriation during the last fiscal year, except to make some local surveys with a view to pre-

paring plans and estimates for further work. The expenditures during the last fiscal year were for this purpose.

No specific appropriation has been made for this work since 1890, the cost of operations, care, and maintenance being provided for by allotments from the permanent-indefinite appropriation for operating and care of canals and other works of navigation.

July 1, 1897, balance unexpended	$4,586.54
June 30, 1898, amount expended during fiscal year	1,527.15
July 1, 1898, balance unexpended	3,059.39

(See Appendix L L 14.)

15. Operating and care of St. Clair Flats Canal, Michigan.—Conforming with the plan that has been followed since the canal was opened to navigation in 1871, a custodian was present on the work during the season of navigation to watch the passage of vessels, enforce regulations respecting navigation through the canal and its approaches, and supervise such work as was requisite for ordinary care and repair of the canal dikes. Expenditures on this account during the fiscal year were $2,099.65.

Commerce on the lakes has become so great that a more efficient control of its passage through the canal has become necessary, and measures for accomplishing this object are now under consideration.

(See Appendix L L 15.)

16. Clinton River, Michigan.—This is a navigable stream emptying into Anchor Bay, in the northwesterly part of Lake St. Clair, with an original channel depth of about 10 feet, except at shoals, over which but 5 or 6 feet could be carried, and a broad flat at the mouth with a general depth of from 3 to 4 feet. In 1870–71 a channel 9 feet deep, 60 feet wide, and 2,700 feet long was dredged through this flat, but being left without works of protection it soon filled in again. In 1885 a project of general improvement was adopted which provided for a through channel 8 feet deep to Mount Clemens (8 miles upstream), for a pile dike extending across the flat at the mouth to the curve of 10-foot depth in the bay, and for revetments as needed above. The estimated cost, as modified in 1889, was $34,564.

The total expenditure to June 30, 1897, was $60,515.99, of which $25,500 was applied to occasional and scattering work done before the adoption of the present approved project in 1895, leaving $35,015.99 as the amount applied to the latter.

As a result of these expenditures, the proposed 8-foot channel was obtained by dredging and kept in a fairly navigable condition by the aid of temporary revetments and occasional redredgings; but the appropriations were at no time sufficient to permit the construction of any protecting works of a permanent character, and in their absence the maintenance of the channel must depend on periodical dredgings.

No work was done on the river between 1893 and 1897, and the channel had in the meantime shoaled to 4½ or 5 feet in many places. Operations for restoring the required navigable depth were therefore commenced June 10 and continued until September 6, 1897, during which time 34,363 cubic yards of material was excavated. The expenditure made during the last fiscal year was for this work, which resulted in restoring the depth of 8 feet from the mouth of the river to the city of Mount Clemens, as contemplated by the approved project.

The balance of funds on hand will probably suffice for doing such dredging as may be needed to maintain the improvement to June 30,

1900, and for this reason no additional estimate is presented for this purpose.

The commerce of the river during the past two calendar years, as shown by the best data obtainable, amounted to 420 entrances and clearances with a freight tonnage of 31,159 for the year 1896, and 420 entrances and clearances with a freight tonnage of 29,077 for 1897, making a total for the two years of 840 entrances and clearances with a freight tonnage of 60,236.

July 1, 1897, balance unexpended	$14,548.01
June 30, 1898, amount expended during fiscal year	7,156.59
July 1, 1898, balance unexpended	7,391.42

(See Appendix L L 16.)

17. Detroit River, Michigan.—The shoalest part of the channel through the Detroit River before improvement was over the rocky ledge about 16 miles below Detroit, Mich., known as the Limekiln Crossing, where the navigable depth at ordinary stages of water was 13 feet. In 1874 a project was adopted for excavating a channel through this obstruction with a view to increasing the depth to 20 feet, and such channel was completed in 1890 to a width of 440 feet. In the meantime the draft of vessels had so increased as to make it necessary to deepen the channel above and below the crossing by the removal of numerous shoals, bowlders, and scattering projections of bed rock, over which depths not exceeding 15 or 16 feet were found in many instances, and the original project of improvement was thereupon extended in 1892, with the ultimate object of removing all obstructions from the channel, so as to give it a navigable depth of 20 feet for a width of 800 feet from the head of Limekiln Crossing to the head of Ballards Reef. The original estimated cost of the Limekiln Channel was $1,374,500 and of the further improvements $180,000, making the total estimated cost $1,554,500.

The amount expended to June 30, 1897, was $740,374.02, the result being to complete the channel at the Limekiln Crossing, as above stated, to a depth of 20 feet and width of 440 feet and to make a navigable depth of 16½ feet at the shoalest points of the Ballards Reef Channel.

Operations during the last fiscal year were in progress until funds available became exhausted, October 2, 1897. The maximum available depth at the shoalest part of the channel June 30, 1898, was thereby increased to 18 feet.

The total amount appropriated for carrying on work under the several projects since 1874 is $793,000, and this, deducted from their total estimated cost, leaves $761,500 as the estimated amount required for their completion; but it is highly probable that it can be done for less if the appropriations are such as to admit of practically continuous work.

July 1, 1897, balance unexpended	$52,736.39
June 30, 1898, amount expended during fiscal year	52,736.39
Amount (estimated) required for completion of existing project	761,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix L L 17.)

18. Rouge River, Michigan.—This stream originally had a channel depth of from 10 to 17 feet for a distance of about 3 miles above its

mouth. Its improvement was commenced in 1888, under a project for securing a regular channel depth of 16 feet, with a width of 240 feet for a distance of 800 feet from the mouth, and thence with a width of 100 feet to the Wabash Railroad Bridge, about 2⅔ miles farther up. The estimated cost was $31,690.39, and the work was completed in 1892. Since then no work of improvement has been done, but under the provisions of the river and harbor act of June 3, 1896, the section of the river heretofore improved was examined in May, 1897, and survey made for estimating the cost of extending the original improvement about 8,000 feet farther upstream.

The total expenditure to June 30, 1897, was $31,794.45. The expenditure for the last fiscal year, amounting to $394, was for office and engineering contingencies, including the preparation of map and report of the examination and survey referred to above, which report, dated November 20, 1897, is printed as House Doc. No. 138, Fifty-fifth Congress, second session, and is submitted herewith as Appendix L L 22.

The following statement indicates the commerce of this river during the past five calendar years, as shown by data compiled from the best information obtainable:

Year.	Tons.	Year.	Tons.
1893	73,732	1896	123,495
1894	47,106	1897	125,373
1895	114,090		

July 1, 1897, balance unexpended	$9,895.55
June 30, 1898, amount expended during fiscal year	394.00
July 1, 1898, balance unexpended	$9,501.55

(See Appendix L L 18.)

19. Turning basin in Rouge River, Michigan.—The river and harbor act of September 19, 1890, called for an estimate for "locating and constructing basin in Rouge River, at a point on the same within 4 miles of its junction with the Detroit River, convenient for the turning and anchoring of vessels." The estimate thereupon submitted was as follows: Three acres of land for site, $4,500; 74,074 cubic yards excavation, $11,111.10; total, $15,611.10. The river and harbor act approved July 13, 1892, appropriated $5,000 for acquisition of land and beginning construction according to this project, but the appropriation has been found too small for purchasing the land needed, and accordingly no work has yet been done or expenditure made.

It is now submitted as doubtful whether the construction of the proposed basin will be really necessary, for private parties have already constructed slips opening into the river, and others will undoubtedly follow that will supply openings opposite to which vessels will be able to find turning room. If, however, the plan of constructing a turning basin is to be adhered to, work should not be commenced until all the money required to complete it has been appropriated. It is therefore suggested that the construction of the turning basin be abandoned, for the present at least, and that the money already appropriated be made available for general dredging in the Rouge River.

July 1, 1897, balance unexpended	$5,000.00
July 1, 1898, balance unexpended	5,000.00

(See Appendix L L 19.)

SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896, AND RESOLUTION OF THE SENATE OF MARCH 22, 1898.

Reports of surveys of the following localities, required by the river and harbor act of June 3, 1896, and estimate for improvement of Saginaw River, Michigan, in compliance with resolution of the Senate of March 22, 1898, were submitted by the local officer, Lieut. Col. G. J. Lydecker, Corps of Engineers, viz:

1. Survey of Saginaw, Shiawassee, Bad, and Flint rivers, Michigan.—Lieutenant-Colonel Lydecker submitted report November 22, 1897, with estimates of cost of improvement, of Saginaw River, from its head to a point in Saginaw Bay, with a view of securing a channel 200 feet wide and an increase in depth to 14 feet from the head of the river to the Third Street Bridge, so called, in Bay City, thence of the same width to Saginaw Bay with a view to securing an increase of the depth of the channel to 16 feet; also plans and estimates for improving the west channel of the Saginaw River between the Middle Ground and West Bay City with a view to securing a depth of said channel of 14 feet; also for improving the Shiawassee River from the Saginaw River to Bad River; Bad River to the village of St. Charles, and the Flint River from the Shiawassee as far as practicable, to such an extent as will afford a reliable navigation for light-draft boats between Saginaw River and the village of St. Charles, and on the Flint River as far as practicable.

Saginaw River.—This river is now being improved by the United States under a project, adopted in 1882, which provides for making a channel 200 feet wide, 14 feet deep from Saginaw Bay to Bay City and 12 feet deep thence to Saginaw.

The improvement suggested by the act contemplates channels 2 feet deeper than those provided for in existing project and an extension of operations 2½ miles farther upstream than any work thus far done, estimated by Lieutenant-Colonel Lydecker to cost, for the main channel, $452,925, and for the west channel, between Middle Ground and West Bay City, $29,700; in all, $482,625. Lieutenant-Colonel Lydecker adds, however, that the improvement could not be completed on this estimate except with large appropriations admitting of continuous work, and that subsequent maintenance will cost at least $15,000 annually.

Shiawassee and Bad rivers.—The projects proposed for these streams provide for dredging a channel 50 feet wide and 6 feet deep in Shiawassee River from Saginaw River to Bad River, and up Bad River to the village of St. Charles, estimated to cost $21,000, but Lieutenant-Colonel Lydecker states that a temporary improvement that would meet the immediate requirements of navigation within the proposed limits could probably be made with an expenditure of $5,000, resulting in a navigable depth of about 5 feet.

Flint River.—The improvement of this stream "as far as practicable" from its mouth, a distance of about 4 miles, by dredging a channel 50 feet wide and 6 feet deep, will cost, as estimated by Lieutenant-Colonel Lydecker, $15,000.

Section 9 of the act of June 3, 1896, also provides for a survey of Saginaw River, and the report and estimate above given are intended to comply with the requirements of this section as well as those of section 1.

The report was transmitted to Congress and printed in House Doc. No. 135, Fifty-fifth Congress, second session. (See also Appendix L L 20.)

2. Estimate of cost of improvement of Saginaw River, Michigan, from its head to a point in Saginaw Bay.—In compliance with resolution of the Senate of March 22, 1898, requiring an estimate of the cost of improving Saginaw River from its head to a point in Saginaw Bay, with a view of securing a channel 150 feet wide and an increase of depth to 16 feet from the head of the river to the Third Street Bridge in Bay City, thence a channel 200 feet in width to the Saginaw Bay, with an increase of depth of the channel to 16 feet, Lieutenant-Colonel Lydecker estimated the cost of securing a channel of the dimensions specified between the points named to be $750,000 if the work is done under continuing contract, and stated that the cost by any other method will be much greater and wholly indefinite. This estimate was transmitted to Congress and printed in Senate Doc. No. 218, Fifty fifth Congress, second session. (See also Appendix L L 21.)

3. Survey of Rouge River, Michigan, from Wabash Bridge crossing to Maples Road, with a view of obtaining a 16-foot depth of water.—No preliminary examination of this section of the river with a view to improvement as above outlined has ever been made by this office.

The cost of dredging a channel 75 feet wide and 16 feet deep is estimated at $33,000.

Lieutenant Colonel Lydecker states that the only industrial establishment at present on this part of the stream is the Detroit Salt Company's works, located near its upper end, and, as the draft which vessels can now carry from the mouth of the river to the Wabash crossing is only about 13 feet, in his opinion the dredging of the shoaler portions in the upper part to such an extent only as would enable vessels that can now reach the Wabash crossing to get through to the salt works might meet all present requirements. The cost of such dredging is estimated at $5,000.

The report was transmitted to Congress and printed in House Doc. No. 138, Fifty-fifth Congress, second session. (See also Appendix L L 22.)

IMPROVEMENT OF RIVERS AND HARBORS ON LAKE ERIE WEST OF ERIE, PA.

This district was in the charge of Col. Jared A. Smith, Corps of Engineers.

1. Monroe Harbor, Michigan.—The harbor of Monroe, Mich., is in the Raisin River, at the extreme westerly end of Lake Erie. Previous to 1835 the river below Monroe flowed to the lake in several tortuous creeks and ponds through a marsh most of which was submerged and impassable except when frozen.

One mouth of the river was in La Plaisance Bay, about 2½ miles south of the present piers. At that place a small breakwater had been built, at a cost of $19,014.87, between 1828 and 1835.

The main outlet of the river was about 1½ miles south of the location of canal and piers which were subsequently built, and the greatest depth at the mouth of the river was about 5 feet.

The improvement planned in 1834 and constructed in 1835 to 1839 consisted in making a direct channel to the lake through a canal 4,000 feet long, 100 feet wide, and 10 feet deep, with piers of timber and stone at the mouth, extending to a depth of 10 feet in the lake. The banks of the canal were protected by sheet piling secured to oak piles and waling pieces.

The city of Monroe subsequently improved the river still further by cutting across the neck of a peninsula a canal 1,400 feet long, having

same cross section and protected in the same manner as the canal constructed by the United States.

In 1845 the north pier was extended 300 feet and the south pier 90 feet farther into the lake. Since 1845 all expenditures for this harbor have been for surveys and maintenance of piers, bank protections, and channel depths. The average annual expense for maintenance, including the present unexpended balance of the appropriation of June 3, 1896, for dredging, has exceeded $2,700.

The piers are now in good condition, the superstructures having been rebuilt under appropriations of 18 2 and 1894. The channel from the lake over the bar is a little more than 9 feet deep at mean lake level, and from the piers to Monroe wharves, a distance of 2½ miles, the channel depths are generally greater than over the bar, except at the upper end, near wharves, where the bottom is solid rock and the least depths are but 8 feet.

The amount expended in construction and maintenance to June 30, 1897, was $240,533.60.

Expenditures of the last fiscal year have been for outstanding liabilities of previous year, for dredging, and its contingent expenses.

Dredging to make a channel 14 feet deep over the bar outside the piers was commenced September 9, 1897, and continued with some interruptions until November 30, when the contractor, having lost a dredge by its being sunk on the edge of the channel, abandoned the work.

The balance of the appropriation will be applied to dredging the channel with the plant belonging to the United States.

The amount estimated for completion of existing project is the unappropriated balance of an estimate of $26,000 in 1891 for repairs.

The river and harbor act of June 3, 1896, required a survey of Monroe Harbor and an estimate of the cost of obtaining a 14-foot depth of water. The report upon the survey was printed in House Doc. No. 102, Fifty-fifth Congress, second session, and is included in Appendix M M 13 of this Report. The estimated cost of the improvement is $626,750.

July 1, 1897, balance unexpended	$4,981.67
June 30, 1898, amount expended during fiscal year	1,537.93
July 1, 1898, balance unexpended	3,443.74
Amount (estimated) required for completion of existing project	11,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	7,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix M M 1.)

2. *Toledo Harbor, Ohio.*—The harbor of Toledo is in the Maumee River. The wharf frontage on the river extends over a distance of about 3 miles, the lower end of which is about 4 miles above the mouth of the river, at the head of Maumee Bay.

Originally the channels in the river were much better than in the bay, having minimum depths of 14 to 16 feet, while in the bay the least depths were 8.5 feet, and the maximum depth for most of the distance was but 12 feet.

In 1866 a project was adopted to dredge the channels of deepest water in the bay to a depth of 12 feet. The project was amended from time to time by increasing the depths until 1887, when the old indirect channel had been dredged to 16 feet, but had filled so that the minimum depth was but 15 feet.

In 1887 a project was adopted for a straight channel through Maumee Bay, with a depth of 17 feet and a bottom width of 200 feet. The estimate of cost, including dikes or other channel protections, was $1,875,000.

The acts of July 13, 1892, August 18, 1894, and June 3, 1896, authorized extending the improvement up the Maumee River. The project for straight channel has been amended by increasing the width of outer section, about 3 miles long, to 300 feet.

Total expended upon old channels, 1866 to 1890	$724,332.61
Expended upon straight channel and channels in river to June 30, 1897	774,459.11
Total for all purposes to June 30, 1897	1,498,791.72

The straight channel had been dredged to full width and depth required, and most of it had been once or oftener redredged to depths of 19 feet or more, in order to provide for maintenance of the less depth of 17 feet. Channels 400 feet wide and 18 feet deep have been dredged over two shoals in the river, each about 4,000 feet long.

At the beginning of the fiscal year dredging was in progress under a contract for widening outer section of channel and cutting southerly division of channel at turn-out section. This work was completed June 11, 1898, leaving outer section of channel full width of 300 feet on the bottom and the depths are from 18 feet to 20 feet. The south turn out around cribs was completed 200 feet wide, so that at the light-houses forming the channel range in Maumee Bay there are now two good channels at the turn-out with very slight change of direction from the main channel at the approaches. The channel inside of turn-out was also dredged next the bank on both sides for a length of 1,600 feet and depth of 20 feet.

The United States dredge plant was employed in completing the channel over the shoal known as "The Crossing" in the river, in dredging a shoal opposite foot of Buffalo street in the river, and in widening and deepening end of straight channel at head of the bay. The channels are now in good condition throughout with depths of about 18 feet at mean lake level.

The sundry civil act of Congress approved June 4, 1897, required "a survey and estimate of cost of deepening and widening the straight channel in Maumee River and Bay, with a view to obtaining and permanently securing a channel of uniform width of four hundred feet and twenty feet deep at low water."

A survey of the entire channel was made between June 24 and October 26, 1897, and the report, with maps, was printed in House Doc. No. 198, Fifty-fifth Congress, second session; it is also submitted as Appendix M M 14 of this report. The improvement proposed is estimated to cost $1,095,000.

The commerce of Toledo has been steadily increasing. In 1897 the freight tonnage reported amounted to 2,409,594 tons.

July 1, 1897, balance unexpended	$123,408.28
June 30, 1898, amount expended during fiscal year	113,029.33
July 1, 1898, balance unexpended	10,378.95
July 1, 1898, outstanding liabilities	505.21
July 1, 1898, balance available	9,873.74
Amount (estimated) required for completion of existing project	980,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	150,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix M M 2.)

3. Port Clinton Harbor, Ohio.—Port Clinton, Ohio, is about 13 miles west of Sandusky by land and 22 miles by water route. The harbor is in the Portage River, near its mouth. Previous to 1873 the depth at the mouth of the river rarely exceeded 5 feet, and the available depth inside did not exceed 7 feet.

In 1873 a channel 20 feet wide and 8 feet deep was dredged from the mouth of the river through the bar to the lake. In 1874 a fence was built upon the point north of the river mouth to stop the drifting sand. In 1875 a plan was adopted to protect both sides of the channel from the river mouth to water of sufficient depth in the lake.

The work consisted mainly of sheet piling of oak plank, secured and reenforced by oak piles, with heavy oak waling pieces. The pierhead of east pier was a solid construction of piles and stone, and 720 linear feet of west pier consisted of a substructure of piles with superstructure of timber crib work, both filled with stone. The estimated cost was $90,000.

The piers had been extended to a depth of 10 feet in the lake in 1883, and no further extension has been considered necessary. The channel has been dredged to a depth of 10 feet over a width of 100 feet between piers and a width of 200 feet inside the shore line. The natural conditions have maintained the depth since dredging. The sheet piling of piers has also been partially protected by riprap stone, piled against it on both sides.

Amount expended to June 30, 1897, including $1,200 paid for part of sand point, was $75,846.42.

At the close of the last fiscal year a contract had been made for reenforcing both piers by a riprap of stone as far as available funds would permit. Work under the contract was nearly completed June 30, 1898.

This will result in greatly adding to the strength of the channel protections, and a large part of the length of piers will be in such condition that when the partly rotted timber above water disappears, the placing of a small stone superstructure will be a matter of small expense with permanent results.

Port Clinton Harbor is not a commercial port, but has some local passenger and freight traffic and a considerable interest in fishing. The freight tonnage in 1897 amounted to 6,226 tons.

July 1, 1897, balance unexpended		$12,153.58
June 30, 1898, amount expended during fiscal year		4,438.45
July 1, 1898, balance unexpended		7,715.13
July 1, 1898, outstanding liabilities	$3,756.40	
July 1, 1898, amount covered by uncompleted contracts	2,785.96	
		6,542.36
July 1, 1898, balance available		1,172.77
Amount (estimated) required for completion of existing project		15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900		6,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix M M 3.)

4. Sandusky Harbor, Ohio.—The harbor of Sandusky is in the lower part of Sandusky Bay along the city front, the nearest part to the lake being about 2 miles from the bar which divides the waters of the bay from the lake.

Originally the harbor depths were only those of the bay, which was about 10 feet deep along the city front, and 9 to 12 feet thence to the lake. In the part known as the "Deep Hole" at Cedar Point, the depth exceeded 18 feet for a length of about 1 mile, and the greatest depth exceeded 40 feet.

In 1826 an appropriation of $400 was made for a survey. The first improvement was made in 1844 by the construction of a dam across a breach in the long point which, in 1826, extended in a peninsula from the mainland on the north nearly to the "Deep Hole" channel at Cedar Point. With this exception all improvements previous to 1896 consisted in deepening natural channels, making a new straight channel from city front to Cedar Point, and in dredging and removing bowlders from dock channel along city front.

In compliance with requirements in the river and harbor act of August 18, 1894, a project was adopted for dredging channels inside the bar to a depth of 17 feet and width of 200 feet, to make a channel 18 feet deep and 300 feet wide over the outer bar, and to construct a jetty from Cedar Point and a dike on opposite side of channel to confine the currents, check the drifting sand, and thus maintain channel depths. The estimated cost was $255,000.

The total expended upon the improvement from 1844 to June 30, 1897, for all purposes was $447,112.55.

Vessels drawing 17 feet had no difficulty in passing over the entire length of channels inside the bar, and over the bar the same draft could be carried with careful piloting. The jetty from Cedar Point had been extended a distance of 800 feet into the lake.

At the beginning of the last fiscal year work was in progress in dredging channels and in extending the jetty of brush and stone, each work being under contract.

The dredging was completed July 24 as far as funds permitted. The full depth of inside channels covered a width of 90 feet on west section of dock channel, 110 feet in east section of dock channel, and 200 feet in straight channel to Cedar Point. Over the bar the channel had a depth exceeding 17 feet over a width of about 90 feet at the narrowest place.

Work upon the jetty from Cedar Point was suspended October 12, 1897, because of completion of contract. The jetty was completed to a point 1,775 feet from the shore. In the spring of 1898 a survey and map disclosed the fact that the channel was in better condition than ever before.

In compliance with the requirements of section 1 of the river and harbor act of June 3, 1896, a survey of the bar at the mouth of Sandusky Bay was made and the report was submitted to Congress March 18, 1898, and printed in House Doc. No. 362, Fifty-fifth Congress, second session; it is also submitted as Appendix M M 16 of this report.

The improvements contemplated are in the nature of extensions to the existing project now in the course of execution.

If Congress appropriates the amount estimated for the fiscal year ending June 30, 1900, it is proposed to expend the funds in completing the jetty from Cedar Point, in constructing a dike on the opposite side of the channel, and in completing the dredging of channels inside the bar.

In 1897 the tonnage as reported at the custom-house was but 991,974 tons; but this is doubtless much too small, as there is a large amount of traffic which is not reported at the custom-house.

July 1, 1897, balance unexpended	$29,679.45
June 30, 1898, amount expended during fiscal year	29,323.16
July 1, 1898, balance unexpended	356.29

Amount (estimated) required for completion of existing project	185,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix M M 4.)

5. Huron Harbor, Ohio.—The Huron River flows into Lake Erie at a point about 10 miles east of Sandusky Bay, and the harbor of Huron is formed by the part of the river about three-fourths of a mile in length above the mouth, to which has been added a large dock or slip excavated through low ground on the east side.

The river is navigable for small vessels as far inland as Milan, a village about 8 miles south of Huron. Formerly the mouth of the river was occasionally closed by a sand bar, and it was in that condition when Congress appropriated $5,000 for its improvement by act of May 20, 1826. Improvements were then undertaken to confine the currents and protect the channel by parallel piers of timber crib work filled with stone.

The piers have been extended and repaired, and the channel has been deepened by dredging as necessities have required, without any radical change in the original plan of improvement. Methods of construction have, however, been recently much improved. The latest project, approved in 1890, was to extend the piers to a depth of 16 feet in the lake. The estimate for the construction only, as revised in 1893, was $145,000.

At the end of the last fiscal year, the west pier, for a length of 340 feet from outer end, was nearly new and in good condition, and 288 feet in length of parts inside had been repaired in 1894 with new superstructure. On the east side a length of 152 feet of the outer end, built in 1893 and 1895, is in good condition. The remaining portions of piers, 892 feet on west side and 770 feet on east side, are in very bad condition, owing to decay, wear, unequal settlement, and other causes, making a total length of 1,662 linear feet, which may protect the channel a few years longer, but unless renewed entirely will ultimately become a pile of débris.

The total expenditure for construction and maintenance of this harbor to June 30, 1897, was $171,525.80.

The expenditures of the year were for dredging the channel outside the piers. The channel has a depth generally exceeding 17 feet at mean lake level, but during several years preceding the present season of 1898 the surface of the lake has been from a few inches to 2 feet below mean level, and the harbor depths shown upon charts have been correspondingly less.

The officer in charge of the improvement does not recommend the farther extension of piers on the present lines, but concludes that the same amount expended in constructing detached breakwaters converging toward the lake will produce far better results.

July 1, 1897, balance unexpended	$747.91
June 30, 1898, amount expended during fiscal year	736.14
July 1, 1898, balance unexpended	11.77

Amount (estimated) required for completion of existing project	117,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	40,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix M M 5.)

6. Vermilion Harbor, Ohio.—The harbor of Vermilion is about 35 miles west of Cleveland, Ohio. It is formed by the part of Vermilion River at and near its mouth.

In 1836, when improvements were commenced, the depth of water over the bar was less than 2 feet. The project for improvement was to confine the channel by parallel piers of timber work, filled with stone, extending across the bar. The piers are 125 feet apart.

The piers were repaired or renewed, and the channel was dredged at various times until 1875, since which date no additions have been made to the length of the piers, but from 1876 to 1879 the rock bottom in the channel was removed to a depth of 14 feet. All expenditures since 1879 have been for maintenance, by repairs or renewal of parts of piers.

The east pier, for a length of 317 feet from the outer end, is in fair condition, the superstructure having been rebuilt in 1892, and about 185 feet more, a length of 502 feet in all, will probably last for several years. The remainder of the pier on east side, a length of about 573 feet, is little better than a ruin. On the west side the outer end, for a length of 72 feet, could be made to last for some years with proper repairs, and a section 90 feet long next to that part is in good condition, having been rebuilt entirely in 1896. The remainder of the west pier, a length of nearly 1,000 feet, is so much worn and rotted that parts of it are apparently ready to fall into the channel at any time.

Amount expended upon Vermilion Harbor from 1836 to June 30, 1897, was $132,256.46.

There is a good channel of 11 feet depth, with a depth of 12 feet at the entrance between piers. The expenses of the last fiscal year have been for examinations of channel and piers and for office contingencies.

The amount remaining to be appropriated of the original estimate for completion of project is entirely inadequate by itself to renew or repair any part of the old piers.

The commerce of Vermilion is very small, but at certain seasons it furnishes a port for small fishing craft, and in the past has been a winter port for several vessels of good size.

July 1, 1897, balance unexpended	$444.82
June 30, 1898, amount expended during fiscal year	425.25
July 1, 1898, balance unexpended	19.57

(See Appendix M M 6.)

7. *Black River (Lorain) Harbor, Ohio.*—In its natural condition the depth of water at the mouth of the Black River did not exceed 3 feet.

In 1828 the mouth of the river was entirely closed by a sand bar. The plan of improvement then adopted was parallel piers of timber crib work filled with stone, extending across the bar into the lake. The piers originally rested upon or very near the surface of the bottom of the lake. They have been repaired, portions rebuilt, and the outer ends extended to deeper water to keep pace as far as possible with increasing demands of commerce, but no radical modification of the original project has thus far been adopted. Methods of construction have, however, been greatly improved in the most recent works.

The latest approved project, adopted in 1893, is to extend the parallel piers to a depth of 17 feet in the lake, at an estimated cost of $56,000, exclusive of all repairs or maintenance.

The total of expenditures for construction and maintenance to June 30, 1897, was $279,548.66.

The west pier is approximately 1,896 feet long, and the east pier 1,562 feet in length. On the east side a section of pier 151 feet long was removed and entirely rebuilt upon a deeper foundation in 1893, and on the west side a section 396 feet long was removed and rebuilt in 1897. The outer end of east pier, a length of 142 feet, and outer end of west pier, a length of 238 feet, built in 1889, 1891, 1893, and 1895, are in good condition. The remainder of both east and west piers is in

very bad condition, and should be rebuilt within a very few years. A length of about 900 feet on the west side has been leased to the Cleveland, Lorain and Wheeling Railroad Company on condition of a proper maintenance.

The work of removing and rebuilding a section of the old west pier, 396 feet long, which was in progress at the close of the last fiscal year, was completed December 24, 1897.

In September and November, 1897, the channel between piers was deepened by dredging to a depth of 19 feet. There is now a good channel exceeding 18 feet in depth at mean lake level between the piers and outside, with a slight tendency for the formation of a bar around the end of east pier.

Under provisions of the river and harbor act of June 3, 1896, a report of a survey of the harbor of Black River (Lorain), Ohio, was submitted by the officer in charge of the improvement in November, 1897; the report was printed in House Doc. No. 131, Fifty-fifth Congress, second session; it is also submitted herewith as Appendix M M 17.

The cost of necessary breakwaters and other improvements to make a harbor easily accessible in all kinds of weather, with a depth of 29 feet at the entrance, is $695,500.

The commerce and business of Lorain Harbor is increasing rapidly.

July 1, 1897, balance unexpended	$12,656.11
June 30, 1898, amount expended during fiscal year	12,653.56
July 1, 1898, balance unexpended	2.55
July 1, 1898, outstanding liabilities	.59
July 1, 1898, balance available	1.96

(See Appendix M M 7.)

8. Cleveland Harbor, Ohio.—The harbor of Cleveland is formed mainly by the navigable portion of the Cuyahoga River, the channel of which, inside the original shore line, has been greatly improved by dredging under the direction of the city authorities and by private enterprise.

Previous to 1825 no improvements had been made and the mouth of the river had no permanent location nor reliable depth. The river, at different times, flowed into Lake Erie at various points, the extremes of which were more than three-fourths of a mile apart. This condition was caused by the sand, which drifted and formed a long point or spit projecting from the east side and forcing the river to take its course westward to the end of the point. At times the mouth of the river was closed entirely during brief intervals until a freshet or other increased flow would result in a new break through the bar.

In 1826, when improvements were first undertaken, the spit extended westward beyond the present west pier, and the middle of the river was about 700 feet west of its present location. The plan of improvement contemplated rectifying the channel so that it would lead more directly into the lake, and to make the new location permanent by piers to confine the channel across the bar and into the lake on each side.

The piers were repaired and extended, parts were rebuilt, and the channel was made deeper and maintained by dredging, as necessities arose, with no change in the general method of improvement until 1875, at which time the total expenditure had been $346,881.61.

In compliance with requirement in the river and harbor act of March 3, 1875, a project was adopted in that year for a breakwater in 5

fathoms of water. The west breakwater was commenced in 1876 and completed in 1883, a total length of 7,130 feet, including shore arm, besides a spur of 100 feet near the harbor entrance. East breakwater was commenced in 1888 upon same alignment as west breakwater, but leaving an opening of 500 feet. This work was continued at intervals until 1893, when its length was 2,494.5 feet.

In 1895 an opening of 200 feet was made in the shore arm of west breakwater as a sanitary measure. In 1896 a length of 450 feet of old east pier outside of harbor line was entirely removed and partly replaced by a substantial pier of timber crib work and stone, with a superstructure of stone and concrete masonry.

Total expenditures for all purposes from 1825 to June 30, 1897, $1,683,792.82.

The depths of water at entrance between breakwaters is from 22 to 24 feet and the central depth between piers generally exceeds 18 feet.

Under provisions of the river and harbor act of June 3, 1896, a project for completing certain improvements at Cleveland Harbor, Ohio, was placed under the continuous-contract system at a cost not to exceed $1,354,000.

At the beginning of the last fiscal year a contract had been executed for repairing west breakwater at an estimated cost of $413,843.78, at contract prices. Operations under this contract were commenced August 1, 1897, and have been carried on continuously, except when suspended during the winter season. Four hundred linear feet of the new superstructure of concrete masonry has been completed, its base being at an average depth of 2.5 feet below mean water level. An additional distance of 50 feet has the heavy concrete blocks set in position and 50 feet farther the old superstructure has been removed and the base for concrete prepared. The outer face of breakwater has been sheathed with oak plank over a length of 750 feet.

A contract has been executed for constructing the stone foundation upon which to complete the east breakwater, a length of about 3,000 feet, at an estimated cost of $92,000. Work under that contract is now in progress. The first delivery of stone under the contract was June 17.

On the 23d of June proposals were opened for constructing part of west pier, removing part of old west pier, dredging channel, and completing east breakwater. Of the nine proposals received, the lowest was that of the L. P. & J. A. Smith Company, of Cleveland, Ohio, the total cost estimated from contract prices for the various items being $450,273.95.

The portions of the project remaining are a portion of west pier construction and river widening, and a contract for such work will be let as soon as title to the land which is required for the purpose has been acquired by the United States.

The river and harbor act of June 3, 1896, required "a survey of the breakwater [outer harbor] as heretofore planned, with a view of determining the advisability of changing the plan thereof," etc.

A complete survey was made, and a report with map submitted by the officer in charge of the improvement, under date of December 2, 1897. The report and map were printed in House Doc. No. 128, Fifty-fifth Congress, second session. The report is also submitted herewith as Appendix M M 18.

The commerce of Cleveland Harbor is very large and is increasing. In the year 1897 the actual freights reported amounted to 6,189,883 *tons*, and seven new lines of transportation were established.

July 1, 1897, balance unexpended		$419,838.79
Amount appropriated by sundry civil act approved July 1, 1898		*294,000.00
		713,838.79
June 30, 1898, amount expended during fiscal year		24,986.99
July 1, 1898, balance unexpended		688,851.80
July 1, 1898, outstanding liabilities	$19,108.04	
July 1, 1898, amount covered by uncompleted contracts	927,273.95	
		946,381.99
Amount (estimated) required for completion of existing project		630,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900		400,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix M M 8.)

9. *Fairport Harbor, Ohio.*—The harbor of Fairport is in Grand River, which was originally navigable for small vessels about 2½ miles from its mouth, but the depth at the mouth of the river was uncertain. In 1825, when the improvement was undertaken, the mouth of the river was entirely closed by a sand bar.

The improvement consisted in constructing parallel piers of timber crib work filled with stone 200 feet apart and extending across the bar to confine the currents and check the drifting sand. The cost of maintenance has been a very large item in the total of expenditures, for parts of the original piers have been rebuilt, all the timber work has been extensively repaired, and the item of dredging to maintain channel depths has been very large. The last extension to piers was in 1893. The total expenditures for construction and maintenance, 1825 to June 30, 1897, was $375,602.76.

The result has been a channel of 19 to 20 feet depth between piers, and generally a depth of 18 to 20 feet from piers to the lake, except when temporarily made less by storms in the late fall and early spring months.

The expenditures of the last fiscal year have been for liabilities of the previous year, for dredging the channel, and for the necessary surveys, office and engineering contingencies.

The river and harbor act of June 3, 1896, appropriated $30,000 for the improvement, and provided that of the amount "not less than twenty thousand dollars shall be applied toward the construction of a breakwater according to the project submitted April third, eighteen hundred and ninety-six."

The project contemplates the construction of two breakwaters converging toward the lake. The expenditure of $20,000 only to commence the breakwaters would not permit of constructing a section sufficiently large to be of any practical service and its proportional cost would be increased. It would furthermore be subject to injuries and deterioration before it would become of service. The expenditure of this sum has, therefore, been deferred until additional funds for the purpose are made available.

In the spring of 1898 the bar had formed near outer end of piers, but in such manner as to leave a narrow channel of 18 feet depth in prolongation of east pier. The channel was buoyed until the bar was removed by dredging in May and June, 1898.

The application to maintenance and repairs of $10,000 of the appropriation of 1896 for this work, has increased the estimate for comple-

* Appropriation was $300,000, with proviso that $6,000 of the amount may be expended for repairs and extension of levee at Zanesville, Ohio.

tion of the project by that amount over the sum stated in the last Annual Report.

Fairport Harbor is a large receiving port for iron ore and grain, which is taken away by rail. Considerable coal is shipped from this port. In 1897, the freight to and from the harbor amounted to 1,565,906 tons.

July 1, 1897, balance unexpended	$30,270.77
June 30, 1898, amount expended during fiscal year	1,781.60
July 1, 1898, balance unexpended	28,489.17
July 1, 1898, outstanding liabilities	769.92
July 1, 1898, balance available	27,719.25
Amount (estimated) required for completion of existing project	490,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	150,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix M M 9.)

10. Ashtabula Harbor, Ohio.—Ashtabula Harbor is in and adjacent to the Ashtabula River near its mouth. The room which the river afforded has been largely increased by wharves and docks constructed by the Pennsylvania and the Lake Shore and Michigan Southern railway companies.

Previous to 1826 the natural conditions at the mouth of the river were varied under the action of storms on the lake and freshets in the river. In 1826 the depth did not exceed 2 feet, and the greatest possible depth under natural conditions was 9 feet to the underlying rock near the shore line.

The improvement, by confining the channel between piers of timber filled with stone 168 feet apart, was commenced in 1826. The piers were subsequently repaired and extended, and the channel was maintained and made deeper by dredging the sand and shaly rock as the increasing necessities of navigation demanded, without any radical change in the principle or general plan of the improvement until 1895.

In 1891 the depths were 17 feet and the original plan was modified by adopting a project to widen the outer part of channel to 213 feet, to extend piers to a depth of 22 feet, and to remove the rock to a depth of 20 feet.

The project of 1891 was but partially carried out when the river and harbor act of August 18, 1894, provided for a survey with a view to making it a harbor of refuge and increasing its capacity for the purposes of commerce. The report was submitted to Congress in Annual Report of the Chief of Engineers, 1895, pages 3122 to 3126, with map. The project modified the previous plan in regard to length of piers, and recommended the construction of two breakwaters converging toward the lake, the outer ends 400 feet apart in water 29 feet deep.

The river and harbor act of June 3, 1896, appropriated $50,000 for improving Ashtabula Harbor and provided that "not less than $40,000 shall be applied toward the construction of breakwaters according to a project submitted," etc.

The entire amount expended for construction and maintenance of piers and channels, 1826 to June 30, 1897, was $608,674.73.

The channel then had a depth of 20 feet throughout from county bridge to the lake; the outer part of channel had been widened to 213 feet and the piers had been extended as far as is now considered necessary. At the close of the last fiscal year the construction of a section 432 feet long for inner end of west breakwater was in process of construction by contract; this work was completed September 28th.

A board fence 650 feet long was constructed across the beach on west side of channel in fall of 1897 to check the movement of sand, and a large number of willows was also planted upon the beach for the same purpose. The effect of the fence and willows is already very noticeable.

In May, 1898, the channel was surveyed and a shoal was buoyed; the shoal was removed by dredging in June.

Ashtabula Harbor has the largest tonnage in iron ore of any port upon Lake Erie.

July 1, 1897, balance unexpended	$53,726.48
June 30, 1898, amount expended during fiscal year	52,473.42
July 1, 1898, balance unexpended	1,253.06
July 1, 1898, outstanding liabilities	480.11
July 1, 1898, balance available	772.95

Amount (estimated) required for completion of existing project	480,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix M M 10.)

11. Conneaut Harbor, Ohio.—The improvement of Conneaut Creek was commenced under an appropriation approved March 2, 1829, for improving the creek by removing the bar at its mouth. Under ordinary conditions the depth over the bar was about 2 feet.

The method of improvement was piers of timber and stone to confine the channel across the bar. From 1829 to 1880 there was expended in construction and maintenance the sum of $112,629.39. No further appropriations were made until 1892.

The original works were planned with reference to the necessities of small sailing vessels of light draft, and the depths obtained had ranged from 8 feet ordinarily to 11 feet under very favorable conditions. The piers were 115 feet apart. In 1880 they were all in the nature of obstructions to be removed.

Under the acts of July 13, 1892, and February 24, 1893, a project was adopted to construct parallel piers 200 feet apart and of sufficient length to extend to a depth of 17 feet in the lake.

In compliance with a joint resolution of Congress approved March 13, 1896, directing the Secretary of War to submit "a plan and estimate for the further improvement of Conneaut Harbor in the State of Ohio," a report and estimate were submitted to Congress in March, 1896. The report was printed in House Doc. No. 325, Fifty-fourth Congress, first session, and in Report of Chief of Engineers, 1896, pages 2969 to 2972.

The project contemplated the construction of two breakwaters converging toward the lake, the completion of a portion of the project for piers, and dredging to a depth of 20 feet, at an estimated cost of $610,000, including $80,000 expended upon the latest project for piers.

The river and harbor act of June 3, 1896, appropriated $40,000 for the improvement and provided that "not less than twenty thousand dollars shall be applied toward the construction of a breakwater according to the project submitted March twenty-fourth, eighteen hundred and ninety-six."

The total expenditures to June 30, 1897, were as follows:

1829 to 1880	$112,629.39
1892 to 1897	81,515.62
Total	194,145.01

A part of west pier 400 feet long and 24 feet wide had been constructed by contract, and a part of east pier 600 feet long and 18 feet wide, extended by a pile revetment 526 feet long inside of shore line, had been constructed by hired labor and purchase of materials by contract. Shoals in channel had been dredged at various times and a part of old west pier had been repaired. The channel depths generally exceeded 17 feet over a width of about 100 feet. The rock bottom projects into channel on east side, so that the full depth can not be obtained on that side until the rock can be removed.

During the season of 1897 a section of west breakwater 282 feet long from the end nearest shore was completed.

A dredge was employed October 26 to December 3, removing material to a depth of 20 feet. In the spring of 1898 the channel was again deepened by dredging to a depth of 20.5 feet. Both piers have received considerable repairs.

The estimate for completing the project at this harbor has been slightly increased in consequence of the necessity in past years of expenditures for repairs and maintenance.

The freight tonnage at Conneaut is increasing rapidly.

July 1, 1897, balance unexpended	$38,481.38
June 30, 1898, amount expended during fiscal year	37,497.99
July 1, 1898, balance unexpended	986.39
July 1, 1898, outstanding liabilities	709.65
July 1, 1898, balance available	276.74

Amount (estimated) required for completion of existing project	499,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	150,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix M M 11.)

12. Removing sunken vessels or craft obstructing or endangering navigation.—In October, 1897, a dredge which was employed in dredging a channel through the bar outside the piers at Monroe Harbor, Michigan, was accidentally sunk in the channel about 750 feet from the end of piers.

The wreck will be removed in July at as early a day as the United States dredge can be spared from other duties upon which it was engaged at the close of the fiscal year.

(See Appendix M M 12.)

SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896, AND SUNDRY CIVIL ACT OF JUNE 4, 1897.

The surveys of the following localities, required by the river and harbor act of June 3, 1896, and the sundry civil act of June 4, 1897, were made by the local officer, Col. Jared A. Smith, Corps of Engineers, and reports thereon submitted:

1. Survey of Monroe Harbor, Michigan, with a view of obtaining a 14-foot depth of water.—Colonel Smith submitted report November 10, 1897, of survey required by the river and harbor act of June 3, 1896.

The harbor of Monroe has generally been understood to include all that part of Raisin River from the head of the wharves to and into the lake, a total distance of a little more than 2½ miles, and has been improved by the United States, the present depths varying from 9 to 12 feet.

Colonel Smith submits a project for securing a 14-foot depth from the lake to the city of Monroe by extending north pier 2,000 feet and south

pier 2,300 feet, dredging over bar, canal revetments on both sides, dredging in river and canals, and blasting and removal of rock in situ; estimated to cost, in all, including contingencies, $626,750. He states, however, that this estimate does not include the expense of maintenance, which will be considerable, and that there is no present or prospective commerce which would justify such an expenditure.

In a report on a preliminary examination of Raisin River, dated August 26, 1896, made in compliance with requirements of section 8 of the river and harbor act of June 3, 1896, Colonel Smith stated (see House Doc. No. 81, Fifty-fourth Congress, second session; also Annual Report of the Chief of Engineers, 1897, p. 3094):

> In view of the facts regarding the location, condition, and commerce of the Raisin River, it is my opinion that the cost of any extension of improvement heretofore planned would vastly exceed the probable benefit to the commerce of the country. Whatever benefits might accrue would be local in extent, and it is doubtful if even the local benefit would be very great.
>
> The maintenance of the piers, canal revetment, and light-house involves all the expense which can be justified by the present or probable commerce or business of the place.

The report was transmitted to Congress and printed in House Doc. No. 102, Fifty-fifth Congress, second session. (See also Appendix M M 13.)

2. *Survey of the straight channel in Maumee River and Bay, Ohio.*—This survey was authorized by the sundry civil act of June 4, 1897, and on December 16, 1897, Colonel Smith submitted report of results. He presents estimates of cost of obtaining a width of 400 feet and a depth of 21 feet at mean level throughout the channels in Maumee River and Bay, as follows:

For river channels	$332,000
For channels and dike in bay	763,000
Total	1,095,000

He expresses the opinion that the channel at the extreme upper part of the wharf frontage, indicated on the map as Division A, is not a thoroughfare, and is used only by a portion of the vessels which pass most of the dredged channel below, and, as a consequence, that a narrower channel here would be sufficient for all necessities of the present or immediate future. If this suggestion is adopted the estimate would be reduced to $1,005,000. Attention is invited to Colonel Smith's remarks regarding maintenance of the work.

The report was transmitted to Congress and printed in House Doc. No. 198, Fifty-fifth Congress, second session. (See also Appendix M M 14.)

3. *Survey of Starve Island Reef, near South Bass Island, in Lake Erie, Ohio, with a view to obtaining a navigable channel 25 feet in depth over said reef.*—This survey was authorized by the river and harbor act of June 3, 1896, and Colonel Smith submitted report of results September 15, 1897. From the data secured, Colonel Smith estimates the cost as follows:

For removing all rock above grade of 21 feet	$258,300
For removing all rock above grade of 25 feet	761,250

In transmitting this report to this office Colonel Smith remarks:

> At the time this survey was required by Congress in the act of June 3, 1896, there were many reasons for believing that the removal of the reef would be attended with less expense and greater benefits than are now estimated. For the reasons set forth in the report, I do not consider that the interests of commerce involved are sufficient to justify the expense, and it is therefore my opinion that the proposed improvement is not worthy of further consideration.

The report was transmitted to Congress and printed in House Doc. No. 103, Fifty-fifth Congress, second session. (See also Appendix M M 15.)

4. Survey of bar at the mouth of Sandusky Harbor, Ohio.—This survey was made under authority of the river and harbor act of June 3, 1896, and Colonel Smith submitted report February 28, 1898.

This locality is now being improved by the General Government under a project which provides for the construction of a jetty from Cedar Point into the lake with a view to extending the Deep Hole channel in the same direction, the construction of a detached dike or breakwater to prevent encroachments on the channel by shifting sand from the westward, and certain dredging.

Colonel Smith states that the forces of the currents in Sandusky Harbor are ample to excavate and maintain a wide and deep channel entirely over the bar, provided they are properly directed, and the project now presented by him has for its object the widening and deepening of the channel by properly directing the current and by the arrest of sand movement. This, in his opinion, can be accomplished by extending the present jetty at Cedar Point as far as may be necessary to hold the outward and eastward currents until their scour has made a channel at least 20 feet deep entirely across the bar; by construction of a "sill" and dam along the top of the bar from the light-house across the "Wagon Track" to Sand Point, and supplemented there by three small jetties; by construction of a dike, approximately 5,550 feet long, parallel to and 725 feet from the jetty; by protection of the slope of the bar south of the light-house with brush mattresses, and by the construction of a dike 1,500 feet long at the outer end of the straight channel, and a small spur on Cedar Point.

The improvements contemplated are in the nature of extensions to the existing project now in course of execution. The cost of completing the existing project is estimated to be $185,000, and Colonel Smith estimates the cost of the extensions now proposed to be $240,796. Total estimated cost, $425,796.

The report was transmitted to Congress and printed in House Doc. No. 362, Fifty-fifth Congress, second session. (See also Appendix M M 16.)

5. Survey of Black River (Lorain) Harbor, Ohio.—This survey was authorized by the river and harbor act of June 3, 1896, and Colonel Smith submitted report of results November 1, 1897, with alternative plans for improvement.

Plan A is designed to afford an entrance 400 feet wide in water 27 feet deep at mean lake level, and is estimated to cost $590,500. Plan B is for a harbor entrance in a depth of 29 feet of water at mean lake level and is estimated to cost $695,500. The local officer remarks that—

> The present indications of development in lake commerce are that the principal freights will be carried in much larger vessels than heretofore, and that harbors which can not afford them a safe entrance and sufficient depth of water will not only fail to increase in business but can hardly avoid suffering great loss in interests previously established.

Respecting the two plans presented in his report, he says:

> Between the two plans, A and B, presented with this report, a glance will be sufficient to show the great superiority of Plan B for every business purpose and for a harbor of refuge. In point of expense only the former plan is to be recommended.
>
> In my opinion it is not wise to limit the provisions for a harbor at such a place to present necessities only, and looking to the future the larger and more expensive plan is the one which will best serve the purposes required.

The report was transmitted to Congress and printed in House Doc. No. 131, Fifty-fifth Congress, second session. (See also Appendix M M 17.)

6. Survey of the breakwater at Cleveland Harbor, Ohio.—Report was submitted by Colonel Smith November 15, 1897, upon survey of the breakwater at Cleveland Harbor, Ohio, as heretofore planned, with a view of determining the advisability of changing the plan thereof so as to abandon the proposed construction of the eastern shore arm, and in lieu thereof extending the breakwater eastwardly in a general direction parallel with the shore, made to comply with requirements of the river and harbor act of June 3, 1896.

Colonel Smith's conclusions may be summarized as follows:

First. Such a modification would greatly increase the exposure of wharves and anchorage to the northerly and northeasterly storms.

Second. The expense of the same length of breakwater would be considerably increased because of the greater depth.

Third. In case of a further extension eastward on the same line the harbor would still have increased exposure to the north and northeast and a greater cost than if built nearer shore.

Fourth. The width between breakwater and end of wharves would be too great.

Fifth. The cost of protecting the harbor from northeast storms by a shore arm, which would ultimately be required, would be greater than if the breakwater were built nearer shore.

Sixth. An extension eastward from the end, as heretofore planned, would afford much better protection to wharves and anchorage at all times, would cost less, would afford ample room between wharves and breakwater, and would be nearly 900 feet nearer shore, with a corresponding decrease in the cost of a shore arm to protect the harbor from northeasterly storms.

These points are deemed by Colonel Smith to be sufficient to indicate that it is not advisable, either with reference to present necessities or future requirements, to abandon the construction of the shore arm of the breakater as now planned.

The report was transmitted to Congress and printed in House Doc. No. 128, Fifty-fifth Congress, second session. (See also Appendix M M 18.)

IMPROVEMENT OF ERIE HARBOR, PENNSYLVANIA, AND OF CERTAIN RIVERS AND HARBORS IN WESTERN NEW YORK.

This district was in the charge of Maj. Thomas W. Symons, Corps of Engineers. Division Engineer, Brig. Gen. G. L. Gillespie, U. S. Volunteers, colonel, Corps of Engineers.

1. Erie Harbor, Pennsylvania.—In its original condition the harbor of Erie was landlocked, the only entrance being to the east; the channel was narrow and tortuous, variable in position, with a depth of about 6 feet.

The original project, prepared in 1823, provided for closing all of the eastern end of the harbor by means of a breakwater, in which should be an opening 200 feet wide, and for extending to deep water in the lake two parallel piers, one on each side of the opening. This project is substantially in force at the present time, except that the piers are 360 feet apart.

The project also includes the necessary work of dredging to keep the channel open, making the necessary repairs to existing structures, and maintaining Presque Isle Peninsula.

The original estimated cost of the existing project is an uncertain quantity. The cost of future work depends so largely upon contingencies that it is impossible to state it with any degree of accuracy.

The cost of pier extension, rendered necessary by sand movements, can be definitely estimated, but the repairs and dredging can not.

The total amount expended for the improvement, preservation, and maintenance of Erie Harbor and Presque Isle Peninsula to June 30, 1897, was $910,462.91.

The results obtained were to establish and maintain a good entrance channel of a depth of 18 feet and at least 275 feet wide, and a commodious deep harbor inside.

During the year a shoal was removed from the outer channel under contract. The work was begun May 2 and finished May 28, 1898. Six thousand five hundred and thirty-five cubic yards of material was dredged, at a cost of $1,110.95.

The commerce of Erie is large and increasing. During the year 1897 there were 3,133 arrivals and departures of lake vessels, with an aggregate tonnage of 4,051,984 tons. The receipts are principally iron ore, wheat, flour, corn, lumber, and copper, and the shipments principally coal. The tonnage of the port has more than doubled during the past ten years, which is largely due to its having been kept in most excellent condition by the Government.

The following table, compiled from the reports of the Chief of Engineers, gives the combined number of arrivals and departures and the tonnage of arriving and departing vessels for the past ten years:

Year.	Arrivals and departures.	Tonnage.	Year.	Arrivals and departures.	Tonnage.
1888	2,111	1,852,601	1893	1,677	1,701,542
1889	2,488	2,351,485	1894	2,687	3,069,545
1890	2,694	2,480,853	1895	2,936	3,323,672
1891	2,437	2,343,566	1896	3,100	3,634,842
1892	2,180	2,409,045	1897	3,133	4,051,984

The maximum draft that can be carried June 30, 1898, at mean low water, over the shoalest part of the locality under improvement, is 17 feet.

In accordance with requirements of the river and harbor act of June 3, 1896, a new project, with estimates, has been submitted, and is printed as House Doc. No. 70, Fifty-fifth Congress, first session, and in Annual Report, Chief of Engineers, for 1897, page 3237.

July 1, 1897, balance unexpended		$36,122.21
June 30, 1898, amount expended during fiscal year		5,177.36
July 1, 1898, balance unexpended		30,944.85
July 1, 1898, outstanding liabilities	$100.00	
July 1, 1898, amount covered by uncompleted contracts	700.14	
		800.14
July 1, 1898, balance available		30,144.71

(See Appendix N N 1.)

2. Harbor at Dunkirk, N. Y.—The harbor at Dunkirk is naturally a simple indentation of the south shore of Lake Erie. It lies between Point Gratiot on the west and Battery Point on the east. Between the two points is a distance of 9,600 feet, and the maximum breadth of the bay behind the line of the two headlands is 3,600 feet. The general

depth of water in the bay was about 10 feet. The bay is underlaid with rock at an average depth of 15 to 16 feet. The object of the improvement is to form an artificially protected harbor in the indentation or bay above described.

The original project was adopted in 1827, and, with its subsequent modifications, provided for the construction of a pier running out from the west shore of the indentation and a detached breakwater parallel with the pier and about 2,000 feet distant from the city front. An opening between the two structures provided a harbor entrance, through which a channel leading to the docks was to be deepened to 13 feet.

In 1870 a Board of Engineers recommended a plan which provided for a detached breakwater 2,860 feet long, one part of which, 2,300 feet long, was to be nearly parallel with the shore, the other part to be nearly parallel with the axis of the channel entrance and 560 feet long.

This breakwater and the pier already built were to form the harbor, and the old channel was to be enlarged to 170 feet wide and 13 feet deep.

All the works now existent at Dunkirk have been built according to this plan. The project adopted by Congress and provided for by the river and harbor act of June 3, 1896, consists of completing the breakwater as before planned by the addition of 360 feet to its eastern end and adding the channel arm 560 feet long, and in addition thereto dredging an entrance channel and a harbor basin, containing in all about 65 acres, to a depth at mean lake level suitable for vessels drawing 16 feet.

The river and harbor act of June 3, 1896, appropriated $10,000 for the work, and authorized the Secretary of War to enter into contract for the whole work at a cost not to exceed $398,258, in addition to the above $10,000.

The total amount expended on the harbor to June 30, 1897, was $563,418.23. At that date the works consisted of an unfinished detached breakwater 1,991 feet in length, a part of the 2,300-foot section provided by the project, a pier 1,410 feet long, exclusive of light-house crib, and a channel 100 feet wide and 13 feet deep. The breakwater and pier consist of timber work, the cribs being filled with stone and decked over.

Contract was made April 15, 1897, for the work authorized by the river and harbor act of June 3, 1896, consisting of the excavation of about 555,000 cubic yards of material, of which about 475,000 cubic yards is mud, sand, gravel, etc., and 80,000 cubic yards is rock; the replacement of 680 linear feet of the decayed superstructure of the west pier with concrete; the building of a timber crib structure along the eastern edge of the proposed entrance channel, and the extension of the breakwater 310 feet to the east, to consist of a timber and stone foundation surmounted by a concrete and stone superstructure; all at an estimated cost of $321,386.85.

A supplemental contract was made August 11, 1897, to increase the depth of the channel entrance to 19 feet and of the basin to 18 feet.

A second supplemental contract was made January 26, 1898, for replacing defective foundation cribs in west pier.

All these contracts were extended by the Chief of Engineers under date of June 22, 1898, to October 15, 1898.

Under the above contracts the excavation of the channel entrance and harbor basin has been about three-fourths completed, the channel arm has been completed, and the breakwater extension and west pier repairs are now in progress.

The commerce of Dunkirk by water is very limited at the present time. During the year 1897 the arrivals and departures of vessels numbered 197, with a total tonnage of 14,745 tons. The receipts by lake were 25,498 tons, and there were no shipments.

The following table gives the total of the arrivals and departures and the tonnage of vessels arriving and departing for the past ten years, as compiled from the Reports of the Chief of Engineers:

Year.	Arrivals and departures.	Tonnage.	Year.	Arrivals and departures.	Tonnage.
1888	32	12,302	1893	58	13,756
1889	68	17,189	1894	137	19,158
1890	100	22,496	1895	69	15,650
1891	96	24,465	1896	42	12,160
1892	58	13,756	1897	197	14,745

The maximum draft that can be carried, June 30, 1898, at mean low-water level over the shoalest part of the locality under improvement is 17 feet.

July 1, 1897, balance unexpended		$398,919.65
June 30, 1898, amount expended during fiscal year		257,100.00
July 1, 1898, balance unexpended		141,819.65
July 1, 1898, outstanding liabilities	$500.00	
July 1, 1898, amount covered by uncompleted contracts	129,685.40	
		130,185.40
July 1, 1898, balance available		11,634.25

(See Appendix N N 2.)

3. Buffalo Harbor, New York.—Buffalo Creek was the original harbor of the port of Buffalo. In its original condition it was shallow and closed by a gravel bar for most of the year. The original project for the improvement of this harbor was adopted in 1826, and provided at first for the construction of piers on the north and south sides of Buffalo Creek. Subsequently a masonry sea wall, running south from the shore end of the south pier, was proposed and built. In 1868 a detached breakwater, about 2,500 feet lakeward from the light-house, to extend south a distance of 4,000 feet, was proposed and adopted. In 1874 it was determined to extend this breakwater to a total length of 7,600 feet. This breakwater now has its full proposed length, the final extension of 806 feet having been built in 1893. It runs parallel with the shore and about half a mile distant from it. In 1874 it was also proposed to build a shore arm to the breakwater, the inshore end to consist of pile work near shore and crib work in the deeper water. Upon reaching the 16-foot contour line in the lake this shore arm was planned to continue in a direction making an angle of 45 degrees with the shore and to overlap the south end of the breakwater, leaving an opening of 150 feet. In 1886 a project was approved for replacing the superstructure as fast as it became badly decayed with concrete. To date, 3,879.13 feet has been so replaced.

In 1895 a new project was adopted for the improvement of Buffalo Harbor. The project consists of the abandonment of the shore arm and the extension of the breakwater from its present southern end to Stony Point. The report of the Board and details of its plans are

published in the Report of the Chief of Engineers for 1895, page 3153, et seq. The river and harbor act of June 3, 1896, added to the project of the Board of Engineers by providing for the construction of a further length of the sand-catch pier, extending it to the established pierhead line.

The project now in force for the improvement of Buffalo Harbor is:

(1) To maintain existing structures, making the requisite minor repairs, and replacing the wooden superstructure of the breakwater with concrete when necessary.

(2) To build an extension of the breakwater from its present southern end to Stony Point, leaving the necessary openings for the convenience of commerce.

(3) To extend the sand-catch pier to the established pierhead line.

As long as only minor repairs are needed, the cost of maintenance of existing structures is estimated at $2,000 per year. There is a stretch of 1,015 feet of wooden breakwater lying between the two concreted portions which will soon require to have its superstructure replaced with concrete. This is the portion which gave the most trouble in building and where the foundation and superstructure are the most insecure. There is 350 feet of timber crib at the outer end of the south pier which requires repairing. The concrete superstructure of the breakwater must soon be built, and its cost is estimated at $125 per foot, or for the 1,015 feet, $126,875. Necessary repairs to the south pier it is estimated will cost $5,000. Two years of other minor repairs will cost $4,000.

The total amount expended by the United States on the improvement of Buffalo Harbor to June 30, 1897, was $2,722,733.15, with the result of obtaining and maintaining a very good harbor. The principal features are north and south piers at the mouth of Buffalo Creek, in which most of the business of the port is done; also an outer breakwater 7,608.6 feet long, built of timber and stone.

A sea wall 5,400 feet long was also built along the lake shore south of the harbor entrance, and a sand-catch pier of piles and stone 870 feet long built out from the shore.

The contractors for the extension of the breakwater and sand-catch pier have at this date finished the sand catch; have partially built 3,000 feet of rubble-mound breakwater; have finished 780 linear feet of the Stony Point section of the timber-crib breakwater, and partially finished about 800 feet additional.

On April 26, 1898, a supplemental contract was made, allowing the contractors to procure the stone from Canada which they had contracted to procure from Lockport, N. Y., the United States to receive a rebate of 5 cents per ton on all stone so procured.

The maximum draft that can be carried June 30, 1898, at mean low water over the shoalest part of the locality under improvement is 20 feet.

The commerce of Buffalo is enormous. During the year the arrivals and departures of vessels by lake and river aggregated in number 10,778 and in tonnage 11,299,091.

The arrivals and departures of canal boats by the Erie Canal were 9,218. The principal receipts by lake and river were wheat, corn, flour, oats, iron ore, lumber, copper, pig iron, glucose, lard, and pork. The total receipts amounted to 8,062,151 tons.

The shipments by lake were principally coal, sugar, salt, and cement, and aggregated 2,686,053 tons.

Assuming that number of arrivals of canal boats equaled the number of clearances, the grand total of the commerce of Buffalo carried on by lake, river, and canal for the season of 1897 is as follows:

Arrivals and departures by lake and river		10,778
Arrivals and departures by canal		9,218
Total arrivals and departures		19,996
Receipts of freight by lake and river	tons	8,062,151
Shipments of freight by lake and river	do	2,686,053
Receipts of freight by canal	do	377,679
Shipments of freight by canal	do	830,285
Total shipments and receipts	do	11,956,168

The commerce of Buffalo depends almost entirely upon the work of harbor improvement done by the United States.

In explanation it may be said that the contract for the work has been let for $1,765,450.63, leaving $434,549.37 for engineering expenses, superintendence, office expenses, and all contingencies. It is quite probable that the work will be completed well within the estimate, but it is too early yet to say so positively or how much within the estimate, and it is deemed proper to leave the amount required for completion of existing project as given below until the work is further advanced.

CONSTRUCTION—NEW WORK.

July 1, 1897, balance unexpended		$469,347.86
Amount appropriated by sundry civil act approved July 1, 1898		489,746.00
		959,093.86
June 30, 1898, amount expended during fiscal year		153,457.07
July 1, 1898, balance unexpended		805,636.79
July 1, 1898, outstanding liabilities	$500.00	
July 1, 1898, amount covered by uncompleted continuous contracts	1,637,754.27	
		1,638,254.27
Amount (estimated) required for completion of existing project		1,229,004.00
Amount that can be profitably expended in fiscal year ending June 30, 1900		485,498.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

MAINTENANCE.

July 1, 1897, balance unexpended	127,164.36
July 1, 1898, balance unexpended	127,164.36
Amount that can be profitably expended in fiscal year ending June 30, 1900	75,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix N N 3.)

4. Tonawanda Harbor and Niagara River, New York.—In its original condition the navigation of Niagara River from Lake Erie to Tonawanda was obstructed by several reefs and shoals which materially limited the draft of vessels traversing it; the water in the harbor between Tonawanda Island and the main shore was shoal, and the river in some places had a very swift current.

The object of the improvement undertaken is to provide a navigable channel from the head of Niagara River at Lake Erie to the north line

of the village of North Tonawanda, and to dredge Tonawanda Harbor to a depth permitting its use by vessels with 16-foot draft.

The adopted project of 1888 is to remove obstructions so as to make a channel 400 feet wide and 18 feet deep, which includes work at the following places:

1. On the Horseshoe Reef at the entrance to Niagara River.
2. On the shoal at the head of Strawberry Island.
3. At a few shoal places abreast of the lower end of Rattlesnake Island.
4. The full width of the river between Tonawanda Island and the mainland along the entire front of Tonawanda.

This project was approved in 1888.

The cost of the work estimated in 1891 was $1,152,987.93. This does not include the work necessary between Tonawanda Island and the north line of the village of North Tonawanda. The amount expended on the general project up to June 30, 1897 was $338,457.16.

At this time the channel through the Horseshoe Reef had been dredged to a depth of 18 feet for a width of 180 feet.

Tonawanda Harbor had been dredged 20 feet wide to a depth of 18 feet along nearly all the length of the Tonawanda Island front.

The commerce of Tonawanda is large. During the year 1897 there were entered and cleared 2,728 lake craft, with a tonnage of 1,116,559 tons. The receipts were principally lumber, iron ore, and limestone, and aggregated 1,240,867 tons. The shipments from Tonawanda amount to very little.

The maximum draft that can be carried June 30, 1898, at mean low water over the shoalest part of the locality under improvement is 15 feet.

The following table gives the entrances and clearances at Tonawanda for the last three years:

	1895.	1896.	1897.
Vessels entered ..... number..	949	1,311	1,355
Vessels cleared ..... do....	951	1,281	1,369
Entering vessels ..... tons..	425,105	466,297	557,748
Clearing vessels ..... do....	441,602	455,000	553,786
Articles received by lake in vessels, rafts, etc ..... do....	894,408	1,015,396	1,240,867
Canal clearances ..... number..	2,120	2,062	2,735
Shipments by Erie Canal ..... tons..	403,358	384,889	502,527
Lumber shipments by Erie Canal ..... feet B. M..	195,886,000	185,580,352	218,576,701

July 1, 1897, balance unexpended	$11,543.84
June 30, 1898, amount expended during fiscal year	11,336.21
July 1, 1898, balance unexpended	207.63
Amount (estimated) required for completion of existing project	802,987.93
Amount that can be profitably expended in fiscal year ending June 30, 1900	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix N N 4.)

5. *Niagara River from Tonawanda to Port Day, N. Y.*—Port Day is the inlet to the old hydraulic power canal at Niagara Falls. It is not and never has been a practical port of commerce, owing to shallow water and its proximity to the rapids at the head of Niagara Falls.

From Port Day up, the river in front of the city of Niagara Falls is very shallow and with rock bed until Conners Island is reached. Between Conners Island and the main shore is a snug little harbor of about 5 acres with a depth of 12 feet at mean river stage and with a maximum depth of about 18 feet.

Above the head of the island there was a shoal with a least depth on it of 7½ feet at mean stage. Above this shoal very good water existed until Cayuga Island was reached. From this island to Tonawanda shoals exist, which require dredging to give a channel of 12 feet depth at low-river stage.

The original project for the improvement of this portion of the Niagara River contemplated the formation of a channel 300 feet wide from Tonawanda down to Conners Island, 200 feet wide from Conners Island to Grass Island, and increasing from 200 to 400 feet wide from Grass Island to Port Day, and construction of an embankment with rock excavated from the channel, extending from Conners Island to Port Day, so as to inclose the lower end of the channel. A channel of 12 feet depth was proposed, although it was incidentally estimated that a channel of 8 feet depth should be first provided, which could be enlarged as an increase of commerce might demand. The cost of the proposed channel, 8 feet deep at mean lake level (6 feet at low water), was estimated at $257,829.

The river and harbor act approved July 13, 1892, appropriated $20,000 for commencement of work on the 8-foot channel.

By act of Congress of August 18, 1894, provision was made for "improving Niagara River from Tonawanda to Port Day, with a view of obtaining a channel of 12 feet depth to Schlossers Dock."

The project as it now stands is, therefore, to provide a channel 12 feet in depth at low water and 200 feet in width from Schlossers Dock back of Conners Island through to Tonawanda by the American channel of the Niagara River. This project is recognized by the river and harbor act of June 3, 1896.

The cost of completing the project was estimated in 1892 to be $230,000. The cost of the work was reestimated last year at $180,000, and it is now determined that the work can be completed for much less than this amount, viz, $50,000, making the total cost of the work contemplated by the project $95,000.

Up to June 30, 1897, there had been expended on the project $28,936.55. By this time a channel 12 feet deep at mean river level and 200 feet wide was completed the entire length of the Conners Island Shoal, about 1,700 feet.

On June 21, 1897, drilling was begun on Cayuga Island Shoal under contract and continued to October 29, 1897, when work was stopped on account of lack of funds. The season's operations resulted in securing a channel across the shoal 81 to 100 feet wide and not less than 12 feet deep at mean lake level.

The commerce involved in the improvement is very small. During the year the total arrivals and departures were 410, all of which were small excursion boats. Whatever benefit the works confer will be upon future commerce.

The maximum draft that can be carried June 30, 1898, at mean low water over the shoalest part of the locality under improvement is 9 feet.

July 1, 1897, balance unexpended	$16,063.45
June 30, 1898, amount expended during fiscal year	15,452.92
July 1, 1898, balance unexpended	610.53
Amount (estimated) required for completion of existing project	50,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix N N 5.)

6. Wilson Harbor, New York.—Wilson Harbor is at the mouth of Twelve-mile Creek, a small stream flowing into Lake Ontario. In its original condition there was a depth of water inside the mouth sufficient for ordinary-sized lake craft, but it was closed by a bar upon which there was ordinarily but about 1 foot of water.

The present project was submitted in 1873, and proposed to extend piers to the 12-foot curve in Lake Ontario, and to dredge a channel 12 feet deep between the piers and from the shore end of the piers to deep water in the creek.

The original estimated cost of the work, as made in 1873, was $90,000. This was increased in 1877 to $100,000.

The amount expended upon the project to June 30, 1897, was $69,962.92. With this money there had been built two piers at the harbor entrance and a shore protection. The piers are prolongations of piers built by private parties in 1846. At present the west pier is 832 feet long and the east pier 850 feet long. There is also a shore protection 360 feet long for the east pier.

The channel was dredged in 1889 to a minimum depth of about 9 feet, but had shoaled since that time.

During the year 1897 the channel was dredged 80 feet wide to its full depth of 12 feet from the lake to the docks in the harbor, and minor repairs were made on the piers.

The commerce of Wilson by water is very small, and is practically confined to a few excursion boats, which come mainly from Toronto.

July 1, 1897, balance unexpended	$16.09
July 1, 1898, balance unexpended	16.09
Amount (estimated) required for completion of existing project	30.000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix N N 6.)

IMPROVEMENT OF HARBORS ON LAKE ONTARIO EAST OF OAK ORCHARD AND OF CERTAIN RIVERS AND HARBORS IN NORTHERN NEW YORK.

This district was in the charge of Maj. W. S. Stanton, Corps of Engineers. Division Engineer, Brig. Gen. G. L. Gillespie, U. S. Volunteers, colonel, Corps of Engineers.

1. Harbor at Charlotte, N. Y.—This harbor is in the Genesee River. In its original condition its lower 5 miles had a channel depth of not less than 18 feet, but across the bar at its mouth vessels could carry only 8 feet.

The original project of 1829 was to obtain a channel across the bar, about one-half mile, 12 feet deep at low water, by constructing two piers of cribs of timber ballasted with stones. In 1883 the depth had been increased to 11 feet by the expenditure of $71,161.05. The piers and channel having deteriorated between 1864 and 1871, the piers were restored and the depth of 12 feet at extreme low water obtained by the total expenditure of $285,420.67, which in 1882 had been increased by the cost of maintenance to $312,098.32.

In 1882 (estimate printed in Annual Report of Chief of Engineers for 1881, p. 2437) the project was increased to obtain the depth of 15 feet by extending the two piers a total of 3,250 linear feet and by dredging, at an estimated cost of $154,000.

In 1896, the piers having been extended a total of 1,444 feet, the project was amended to preserve the depth by dredging without further extension of the piers, at least for the present, and in 1897 it was altered to obtain a *depth of 16 feet* at extreme low water.

The amount expended to June 30, 1897, was $511,922.21. At that date the depth in the channel across the bar between the piers and in advance of them was 14 feet at extreme low water.

With the amount expended during the fiscal year ending June 30, 1898, 49,973.4 cubic yards of mud, silt, and sand was removed.

July 1, 1897, balance unexpended	$9,406.19
June 30, 1898, amount expended during fiscal year	8,931.64
July 1, 1898, balance unexpended	474.55
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	7,000.00

(See Appendix O O 1.)

2. *Harbor at Great Sodus Bay, New York.*—In its original condition the channel connecting this bay with Lake Ontario was wide and impracticable for vessels drawing more than 8 feet.

The original project was to build a breakwater along the narrow beach, or in the shallow water between the bay and Lake Ontario, and to deepen the entrance channel to 12 feet at low water by building 2 parallel jetties and by dredging.

In 1882, when $361,771.80 had been expended, the project was increased to obtain the depth of 15 feet at low water (zero of Oswego gauge) by extending the jetties a total of 1,100 linear feet, and by dredging, at an estimated further cost of $100,000. (Report for 1881, page 2442.)

In 1896, the jetties having been extended 539 linear feet since 1882, the project was altered to obtain and preserve the depth by dredging without further extension of the jetties into the lake, at least for the present.

The amount expended to June 30, 1897, was $471,001.13. At that date the controlling depth in the channel was 15 feet at low water.

With the amount expended during the fiscal year ending June 30, 1898, a shoal of hardpan has been removed from the entrance to the channel.

July 1, 1897, balance unexpended	$4,645.67
June 30, 1898, amount expended during fiscal year	3,217.47
July 1, 1898, balance unexpended	1,428.20
July 1, 1898, outstanding liabilities	332.53
July 1, 1898, balance available	1,095.67
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	14,000.00

(See Appendix O O 2.)

3. *Harbor at Little Sodus Bay, New York.*—In its original condition the channel connecting this bay with the lake was about 150 feet wide and 18 inches deep.

The original project of 1854 was to deepen the channel by building two parallel piers across the bar to the 15-foot curve in the lake, and to connect them with the shore by riprap.

In 1867 the project was enlarged to dredge to the depth of 12 feet.

In 1882, when $232,725.37 had been expended, the project was again increased to obtain the depth of 15 feet by building the piers to the

15 foot curve in the lake and by dredging, at an estimated further cost of $80,000. (Report for 1882, page 2449.)

The amount expended to June 30, 1897, was $323,779.40. At that date the controlling depth in the channel was 15 feet, zero of the Oswego gauge.

With the amount expended during the fiscal year ending June 30, 1898, 3,800 cubic yards of sand and silt was removed.

July 1, 1897, balance unexpended		$9,162.37
June 30, 1898, amount expended during fiscal year		5,407.83
July 1, 1898, balance unexpended		3,754.54
July 1, 1898, outstanding liabilities	$447.84	
July 1, 1898, amount covered by uncompleted contracts	1,850.00	
		2,297.84
July 1, 1898, balance available		1,456.70
Amount that can be profitably expended in fiscal year ending June 30, 1900, for maintenance of improvement. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		5,500.00

(See Appendix O O 3.)

4. Harbor at Oswego, N. Y.—In its original condition this harbor, within the mouth of the Oswego River, which could be entered only by vessels of light draft, and in a cove at the mouth formed by the receding shores of the lake, had no protection against the seas from Lake Ontario.

The original project of 1827 was to build across the cove a breakwater of timber cribs filled with stones, and in 1829 it was completed, 2,150 feet long, at a cost of, approximately, $43,000.

Between 1830 and 1838 500 feet of masonry superstructure was built.

Between 1866 and 1869 $41,000 was expended in dredging the harbor to the depth of 12 feet at extreme low water.

Between 1868 and 1870 the light-house pier was extended northerly 437 feet.

An outer breakwater 5,800 feet long, west of the Oswego River, was completed in 1881.

In 1881 (act of March 3 and Report for 1881, p. 2448) a project was adopted to build an east breakwater 2,700 feet long and to dredge the entrance to the harbor to the depth of 15 feet at low water, at an estimated cost of $540,000; 248 feet was constructed in 1881 and removed in 1889.

Two spurs, exterior and at right angles to the outer breakwater, to diminish the waves that sweep across the entrance, were completed, 100 feet and 150 feet long, in 1885 and 1894.

In 1893 (sundry civil act of March 3) the excavation of rock in the river was added to the project, and a further appropriation was made for this purpose in 1894.

In 1896 the project also provided for narrowing the opening made in the outer breakwater by a storm in 1884 and for continuing the removal of rock from the Oswego River.

A special report made by Major Kingman under date of June 8, 1895, presents a project for building an east breakwater 1,435 feet long, at an estimated cost of $197,000.

The amount expended upon this improvement to June 30, 1897, was $1,866,038.25.

At that date there were 6,720 feet of outer breakwater, spurs, and pier extension, and 2,795 feet of inner breakwater, making 9,515 feet

of breakwater intact, forming an outer harbor containing 80 acres where the depth is not less than 12 feet, of which there are 34 acres where the depth is not less than 15 feet at low water, and an inner harbor of 9½ acres, with a depth not less than 10 feet at low water.

In the Oswego River above the two islands the area 15 feet deep at low water had been enlarged by rock excavation to 3¾ acres.

With the amount expended during the fiscal year ending June 30, 1898, 976 cubic yards of rock was excavated to the depth of 16 feet at low water in removing a shoal at the entrance to the Oswego River; 14,320.1 cubic yards of sand and gravel was dredged from the easterly side of the easterly shore return of the outer breakwater and in the outer harbor along the outer breakwater; three small breaches in the outer wall of the outer breakwater under water were closed; five corners of cribs on the lake face of the breakwater where the front and tie walls had separated were secured; the entire lake face of the breakwater was examined by a diver to search for and stop small breaches; 35 feet of the inner breakwater adjoining the light-house pier was rebuilt above the low-water line; three cast-iron mooring posts were purchased and secured on the easterly shore return of the outer breakwater, and minor repairs were made to both decks of the outer breakwater by the renewal of plank.

July 1, 1897, balance unexpended	$36,574.62
June 30, 1898, amount expended during fiscal year	16,096.60
July 1, 1898, balance unexpended	20,478.02
July 1, 1898, outstanding liabilities	2,148.00
July 1, 1898, balance available	18,330.02
Amount that can be profitably expended in fiscal year ending June 30, 1900. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	50,000.00

(See Appendix O O 4.)

5. *Harbor at Sacketts Harbor, N. Y.*—In its original condition the use of this harbor was restricted to vessels drawing 6 to 9 feet of water.

The project of 1882 was to deepen it to 12 feet by dredging. In 1884 the project was extended to include building a crib of timber, ballasted with stone, on the shoal in the harbor, and to connect it with the end of Shiphouse Point by a brush and stone dike, and in 1896 to include building two groins of stone to protect the point from erosion.

To June 30, 1897, $16,418.29 had been expended. At that date the crib and the brush dike had been constructed, and about 5 acres had been dredged to the depth of 12 feet, but had shoaled, diminishing the depth to 10 and 11 feet, and two groins of stone had been built.

With the amount expended during the fiscal year ending June 30, 1898, an area of about 5 acres in the harbor, which had shoaled to about 10 feet, was redredged to 12 feet, completing the project.

July 1, 1897, balance unexpended	$3,581.71
June 30, 1898, amount expended during fiscal year	3,581.71

(See Appendix O O 5.)

6. *Harbor at Cape Vincent, N. Y.*—This is a new work. Cape Vincent is in the St. Lawrence River, 2½ miles from Lake Ontario, and above a channel difficult to navigate at night. Vessels bound up the lake lie there when weather-bound or when bound down the river at night or in thick weather.

The project, for which $25,000 was appropriated by the act of June 3, 1896, without previous survey, is to build a breakwater parallel to and 600 feet from the railroad wharf, 1,600 feet long, at an estimated cost of $320,000.

A survey made in 1896 showed that a foundation can be obtained at materially less depth and a breakwater built at less cost parallel to and 500 feet from the railroad wharf, but until Congress has taken action upon such modified project, which was presented in Appendix N N 7 of the Report for 1897, it is not considered permissible to commence work at the new location.

From a final examination of the foundation in May, 1897, it is estimated that a breakwater of timber cribs, ballasted with stone upon a rubble foundation, can be built at a cost of $200,000.

To June 30, 1897, $223 had been expended upon the examination and survey of the site.

July 1, 1897, balance unexpended	$24,777.00
June 30, 1898, amount expended during fiscal year	24.29
July 1, 1898, balance unexpended	24,752.71
Amount (estimated) required for completion of existing project	295,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	75,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix O O 6.)

7. *Shoals between Sister Islands and Crossover Light, and between Ogdensburg and the foot of Lake Ontario, St. Lawrence River.*—In its original condition the channel of the St. Lawrence, for 11 miles, extending from Sister Islands Light down to the head of Brockville Narrows, 15 miles above Ogdensburg, was obstructed by 12 shoals (ledges) in the track of vessels, on which the depth was 9½ to 16 feet at low water.

The original project, act of September 19, 1890, was to remove to 18 feet below the zero of the Ogdensburg gauge Blind Bay, Dark Island, and Haskell ledges, between Sister Islands and Crossover Light, at an estimated cost of $43,305.

In 1893 the project was amended to include the removal of outlying spurs of Haskell Shoal, increasing the cost of the project to $54,772.

The acts of August 18, 1894, and June 3, 1896, authorized expenditure for improving shoals in the St. Lawrence between Ogdensburg and the foot of Lake Ontario, and on October 25, 1894, the project was extended to include the removal of certain smaller shoals.

The removal of Dark Island Shoal and Blind Bay Shoal to a depth 1.4 feet greater—i. e., to 18 feet below the zero of the Oswego gauge—was included in the improvement April 13, 1897.

To June 30, 1897, $21,085.77 had been expended. With the amount expended during the fiscal year ending June 30, 1898, Dark Island Shoal and Blind Bay Shoal have been deepened to 18 feet below the zero of the Oswego gauge by the removal of 3,562 cubic yards of rock.

July 1, 1897, balance unexpended	$26,914.23
June 30, 1898, amount expended during fiscal year	26,666.73
July 1, 1898, balance unexpended	247.50
Amount (estimated) required for completion of existing project	60,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix O O 7.)

8. *Harbor at Ogdensburg, N. Y.*—This improvement is to deepen a channel 1⅜ miles in length close along the front of Ogdensburg, on the St. Lawrence and Oswegatchie rivers, and three channels to give access to it across the shoal that separates it from the main channel of the St. Lawrence, one leading to the mouth of the Oswegatchie and two a mile below it.

In their original condition in 1868 the depth at low water was 9½ to 10 feet in the old harbor in the Oswegatchie, 8½ to 12 feet close to the wharves a mile below, 6 feet in the channel along the city front connecting those localities, 9 feet in the channel leading to the mouth of the Oswegatchie, and 10 to 12 feet where the two lower entrance channels have been dredged.

The project of 1868 was to dredge to the depth of 12 feet at the lowest stage of water: (1) The channel of the Oswegatchie River below the bridge between the wharf lines; (2) at the wharves a mile below; (3) a channel 150 feet wide along the city front connecting those localities; and (4) a channel 300 feet wide across the shoal between the channel of the St. Lawrence and the Oswegatchie, and to build, if necessary, 5,500 linear feet of pile-protecting piers, at an estimated cost of $100,000. (Report for 1868, p. 271.) This project was completed in 1896 by dredging, and without piers.

The project of 1882 provided for dredging the channel across the shoal to the mouth of the Oswegatchie to 16 feet, and all the other channels to 15 feet, at extreme low water, at an estimated cost of $76,000. (Report for 1882, p. 2461, and act of August 2, 1882.) Because of the quantity of hardpan met with, the estimate for this project was increased to $108,000. (Report for 1885, p. 2295.)

In 1890 the project provided for dredging all the channels to the depth of 16½ feet below the zero of the Ogdensburg gauge (15 feet below the zero of the Oswego gauge). (Report for 1890, p. 2872.) The project was extended February 27, 1897, to dredge to a depth 1 foot greater, i. e., to 16 feet below the zero of the Oswego gauge—17 feet at ordinary low water—the two lower entrance channels and adjacent parts of the wharf channel without exceeding the estimated cost of the project of 1890.

To June 30, 1897, the amount expended was $264,243.40. At that date the controlling depth at low water (zero of Oswego gauge) was: In the channel leading to the Oswegatchie, 11¼ feet; in the Oswegatchie, 15 feet; in the channel along the city front, between the Oswegatchie and the lower harbor, 12 feet; in the lower harbor and in its two entrance channels, 14 feet.

With the amount expended during the fiscal year ending June 30, 1898, 107,621 cubic yards of sand, silt, and mud, with some hardpan and bowlders, was removed.

July 1, 1897, balance unexpended	$18,112.16
June 30, 1898, amount expended during fiscal year	17,963.34
July 1, 1898, balance unexpended	148.82
Amount (estimated) required for completion of existing project	37,944.44
Amount that can be profitably expended in fiscal year ending June 30, 1900	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix O O 8.)

EXAMINATION OF RESERVOIR SITES IN WYOMING AND COLORADO, MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The examination of reservoir sites in Wyoming and Colorado was made by Lieut. Col. Hiram M. Chittenden, U. S. Volunteers, captain, Corps of Engineers, and report, dated November 6, 1897, submitted, in accordance with a provision of the river and harbor act of June 3, 1896, as follows:

For the examination of sites, and report upon the practicability and desirability of constructing reservoirs, and other hydraulic works necessary for the storage and utilization of water, to prevent floods and overflows, erosion of river banks and breaks of levees, and to reenforce the flow of streams during drought and low-water seasons, at least one site each in the States of Wyoming and Colorado.

Colonel Chittenden entered upon this duty with zeal and with more than ordinary personal interest, and his very admirable report shows deep research and a close study of the subject in hand, involving the examination of a vast amount of data and of territory of wide extent. This paper is accompanied by 13 maps and diagrams and 26 photographs.

Colonel Chittenden's report was transmitted to this office by Lieut. Col. Amos Stickney, Corps of Engineers, who has had large experience in connection with Western rivers, and attention is invited to his remarks touching the construction of these reservoirs.

The report was transmitted to Congress and printed in House Doc. No. 141, Fifty-fifth Congress, second session. (See also Appendix P P.)

SURVEY MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The survey of *Shag Rocks, Arch Rock, Blossom Rock, Two Mission Rocks, and Anita Rock, San Francisco Harbor, California*, was made by Col. Chas. R. Suter, Corps of Engineers, and report thereon submitted October 13, 1897. The estimated cost of removal is as follows:

Anita Rock, to depth of 30 feet below mean low water	$253,080
Arch Rock, to depth of 30 feet below mean low water	503,040
Shag Rocks:	
No. 1, to depth of 30 feet below mean low water	76,000
No. 2, to depth of 30 feet below mean low water	59,580
Blossom Rock, to depth of 30 feet below mean low water	92,600
Two Mission Rocks:	
Mission Bay Rock, to depth of 26 feet below mean low water	112,000
Sonoma Rock, to depth of 25 feet below mean low water	10,000
Total	1,106,300

Colonel Suter states that—

If this work, or any part of it, should be undertaken, it would undoubtedly be necessary to make contracts for the entire completion of each rock by itself. The amount to be appropriated at any one time should therefore be the entire estimate for at least one of these rocks.

The report was transmitted to Congress and printed in House Doc. No. 105, Fifty-fifth Congress, second session. (See also Appendix Q Q.)

IMPROVEMENT OF RIVERS AND HARBORS IN CALIFORNIA SOUTH OF SAN FRANCISCO.

This district was in the charge of Maj. Chas. E. L. B. Davis, Corps of Engineers, having under his immediate orders Lieut. Herbert Deakyne, Corps of Engineers, to January 10, 1898, and Capt. James J. Meyler, Corps of Engineers, since July 3, 1897. Division Engineer, Col. Chas. R. Suter, Corps of Engineers.

1. San Diego Harbor, California.—San Diego Harbor is just to the northward of the national boundary of Mexico and 482 nautical miles to the southward of San Francisco.

Before the adoption of the present project the work carried on had for its object the preservation of the harbor, which was being injured by the deposit of material brought down the San Diego River during flood stages, and for this purpose a dike was built across the mouth of the river and a new channel excavated, causing the river to empty into False Bay. This work was completed in 1876 at a cost of $79,798.72.

The present project for the improvement of the harbor, approved December 8 and 30, 1890, has for its object the construction of a jetty on Zuninga Shoal at the entrance to the harbor, the maintaining of a channel 24 feet deep at mean low tide and 500 feet wide through the middle ground, and the repairs of the dike. The jetty was to be about 7,500 feet long, extending from Coronado Island out on Zuninga Shoal with a view to gaining 26 feet at mean low tide on the outer bar, where the survey of 1887 showed a depth of 21 feet. The estimated cost of this improvement was $394,400.

The amount expended up to the close of the fiscal year ending June 30, 1897, was $289,715.10, and the jetty had been carried a distance of 2,464 feet seaward up to high water and a foundation course of brush and stone 891 feet farther. The depth of 21 feet has been maintained.

During the fiscal year ending June 30, 1898, no work was done on this improvement, as the contract for repairing the dike across the mouth of the old river, to divert its waters into False Bay, and the contract for extending the jetty were both completed during the fiscal year ending June 30, 1897.

July 1, 1897, balance unexpended	$2,784.90
June 30, 1898, amount expended during fiscal year	26.25
July 1, 1898, balance unexpended	2,758.65
Amount (estimated) required for completion of existing project	184,400.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	80,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix R R 1.)

2. Deep-water harbor at San Pedro Bay, California.—The river and harbor act of June 3, 1896, provided for the appointment of a Board to determine upon the location of a deep-water harbor for commerce and refuge in Santa Monica Bay, California, or at San Pedro, in the same State, the decision of a majority of the Board as to location to be final. The Board was to make plans, specifications, and estimates for said improvement. After the Board had rendered its decision and submitted its report the Secretary of War was empowered to make contracts for the completion of the selected harbor in accordance with the project of the Board at a cost not exceeding in the aggregate $2,900,000.

In accordance with the provisions of this act a Board was appointed, which submitted its report March 1, 1897, deciding in favor of San Pedro Bay. The report of the Board is printed in Senate Doc. No. 18, Fifty-fifth Congress, first session.

Bids were solicited by public advertisement dated December 10, 1897, and opened February 10, 1898, seventeen bids in all being received, ranging from $1,303,198.54 to $4,595,516. The bids, with an abstract, were submitted to the Secretary of War, and with his approval, dated July 19, 1898, the proposal of Messrs. Heldmaier & Neu was accepted and contract for the work was awarded them, the breakwater to be constructed under their bid at a cost of $1,303,198.54.

The sum of $400,000 was appropriated for this work by the sundry civil act approved July 1, 1898.

July 1, 1897, balance unexpended	*$14,144.66
Amount appropriated by sundry civil act approved July 1, 1898	400,000.00
July 1, 1898, balance unexpended	414,144.66
July 1, 1898, outstanding liabilities	177.27
July 1, 1898, balance available	413,967.39
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	400,000.00

(See Appendix R R 2.)

3. *Wilmington Harbor, California.*—Wilmington is situated at the head of a small estuary, which has its outlet in the bay of San Pedro, and is 393 nautical miles to the southward of San Francisco.

Previous to the commencement of the improvement, in 1871, there was a depth of less than 2 feet of water at low tide at the entrance.

The original project, approved July 1, 1871, contemplated gaining a depth of 10 feet at mean low tide by constructing 6,700 linear feet of breakwater of sheet piling and crib work filled with stone, at an estimated cost of $400,000, but, owing to the destruction of part of the structure by storms and other causes, the total cost of this project was increased to $555,000.

In 1881 a further project to increase depth of channel from 10 to 15 feet at mean low tide by dredging a reef and between the jetties, raising existing works, and extending the jetties to 18 feet of water in San Pedro Bay, at an estimated cost of $291,766, was submitted. But on account of smallness of appropriations and consequent delay in prosecuting the work—preventing proper control over currents and other physical conditions—this amount was found to be inadequate, and in 1886 was increased to $400,000.

In 1894 a project was submitted by the local officer in charge for a channel 18 feet deep at mean low tide, which would permit drafts of 22 to 24 feet at high tide, at an estimated cost of $392,725, and, in obedience to a resolution of the United States Senate, the Chief of Engineers submitted this report on February 7, 1895. The river and harbor act of June 3, 1896, appropriated $50,000 for improving the harbor in accordance with this plan, but with certain provisos regarding expenditures.

Up to the close of the fiscal year ending June 30, 1897, the amount expended on this improvement was $952,853.43, though no work has been done since 1894.

By this expenditure the available channel depth had been increased from 2 feet to 14.5 feet at mean low tide, and as the high tides average nearly 6 feet, vessels drawing over 20 feet could make the entrance.

The river and harbor act of June 3, 1896, provided for the appointment of a Board to decide whether a harbor of refuge should be established at Santa Monica or San Pedro (outer harbor of Wilmington), with the condition that if San Pedro was chosen existing appropriations for the Wilmington Harbor should not be expended. The Board having selected San Pedro, the expenditure of existing appropriations is prohibited, and without further action of Congress the presenting of an estimate for the additional sum required for the completion of the improvement of this harbor is not permissible.

* The remainder of the appropriation of $50,000, made by the river and harbor act of June 3, 1896, for deep-water harbor at Santa Monica Bay or San Pedro Bay, California, was expended by the Board provided by said act.

July 1, 1897, balance unexpended	$52,146.57
June 30, 1898, amount expended during fiscal year	685.57
July 1, 1898, balance unexpended	51,461.00
July 1, 1898, outstanding liabilities	40.00
July 1, 1898, balance available	51,421.00

(See Appendix R R 3.)

4. San Luis Obispo Harbor, California.—San Luis Obispo Harbor is 9 miles to the southward and westward of the town of San Luis Obispo, 216 nautical miles from San Francisco.

It is a bight of the coast about 18 miles long between Point San Luis on the north and Point Sal on the south. The upper end, where Port Harford is situated, has a wharf, and is the part used for commercial purposes. Whaler Reef, extending nearly half a mile to the southward and eastward of Point San Luis, forms more or less of a natural breakwater, but during the winter season it is exposed to the heavy swell caused by southerly gales.

The original project, approved September 22, 1888, was to construct a breakwater of rough stone on Whaler Reef, extending from Point San Luis to Whaler Island and thence to a point where the outer reef rises above high water. Its length when completed, including the island, was to be nearly 2,000 feet, and it was to be brought up to the plane of mean low water. The estimated cost was $284,989. This project was subsequently modified January 17, 1893, so as to raise the structure up to a height of 6 feet above high water, with a thickness on top of 20 feet and such side slopes as may be assumed under the action of the sea, at an estimated cost of $568,660.

The amount expended up to the close of the fiscal year ending June 30, 1897, was $122,619.85.

On the above-mentioned date the breakwater had been extended out 700 feet from Whaler Island, of which distance 510 feet had been brought up to a height of 6 feet above high water, 40 feet to high water, and 150 feet to mean low water. This makes the total length of breakwater, including the island, 1,281 feet, leaving 700 feet yet to complete the breakwater.

During the fiscal year ending June 30, 1898, the breakwater was extended 130 feet, 90 feet of which has been brought up to a height of 4 feet above high water and 40 feet to mean low water.

July 1, 1897, balance unexpended	$52,380.15
June 30, 1898, amount expended during fiscal year	48,845.28
July 1, 1898, balance unexpended	3,534.87
Amount (estimated) required for completion of existing project	393,660.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	70,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix R R 4.)

IMPROVEMENT OF OAKLAND HARBOR, OF SAN JOAQUIN AND SACRAMENTO RIVERS AND TRIBUTARIES, CALIFORNIA, AND OF RIVERS AND HARBORS IN CALIFORNIA NORTH OF SAN FRANCISCO.

This district was in the charge of Capt. Cassius E. Gillette, Corps of Engineers, to July 7, 1897, having under his immediate orders Capt. James J. Meyler, Corps of Engineers, to July 3, 1897; in the temporary charge of Maj. Chas. E. L. B .Davis, Corps of Engineers, from July 7 to October 18, 1897, and in the charge of Maj. W. H. Heuer, Corps of Engineers, since October 18, 1897, with Lieut. Meriwether L. Walker, Corps of Engineers, under his immediate orders from May 4 to 14, 1898. Division Engineer, Col. Chas. R. Suter, Corps of Engineers.

1. Oakland Harbor, California.—[This work was in charge of Col. Chas. R. Suter, Corps of Engineers, to November 16, 1897.] The principal features of this improvement as originally projected are (1) two mid-tide training walls of rubblestone extended from the shore westward into San Francisco Bay about 2 miles; (2) a connection by a canal 1½ miles in length with the estuary of San Leandro; (3) a dam at the mouth of this estuary; (4) dredging of basins and channels to give a depth of 22 feet at low water, which, at high tide, will accommodate vessels of the largest class.

Two modifications of the original project have been adopted, namely, to increase the width of tidal canal from 300 to 400 feet and to raise the crest of jetties from half tide to full high water. In the original condition of the entrance the low-water channel depth was about 2 feet, admitting at time of high tide vessels drawing 6 to 8 feet of water.

The total amount appropriated for improving harbor at Oakland, Cal., to June 30, 1897, was $2,004,600, and the total amount expended to that date was $1,776,449.22. During the fiscal year $4,821.60 has been expended, making a total to June 30, 1898, of $1,781,270.82.

The facilities for navigation on June 30, 1898, permitted vessels drawing 19 feet of water to pass from San Francisco Bay to Oakland at ordinary high water. The low-water depth of 20 feet held over 8,500 feet. There was a depth of 18 feet over 1,800 feet of length, and for the remaining 8,500 feet the low-water depth was 14 feet. The shoalest spot is on the bar just off the mouth of jetties, where the available depth is 13 feet at low water. The width of this channel was about 300 feet. In the upper harbor the basin channel, originally made 200 feet wide and 8 feet deep, had shoaled 2 feet in four years. No work was done during the year on the dredged channel.

Contract for continuing the dredging in the jetty and city front channels was made April 5, 1898. At the end of the fiscal year work had just been commenced.

The sundry civil act, June 4, 1897, appropriated $200,000 for continuing the improvement of Oakland Harbor, and at the same time modified the act of June 3, 1896, so as to allow this improvement to go on under the existing project to the extent of $686,000, but without reference to its completion, and authorizes continuing contracts, which, however, must not obligate the Government in advance of appropriations for a larger expenditure in any one year than 25 per cent of the total amount authorized to be expended, viz, $686,000.

It is proper to add that it is not believed that the work can be completed with the sum remaining to be appropriated under the existing estimate, but that this sum will have to be increased.

July 1, 1897, balance unexpended	$228,150.78
Amount appropriated by sundry civil act approved July 1, 1898	133,000.00
	361,150.78
June 30, 1898, amount expended during fiscal year	4,821.60
July 1, 1898, balance unexpended	356,329.18
July 1, 1898, amount covered by uncompleted contracts	101,500.00
July 1, 1898, balance available	254,829.18
Amount (estimated) required for completion of existing project	388,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	133,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix S S 1.)

2. San Joaquin River, California.—Before improvement the low-water channel to Stockton was *only 6 feet* in depth and contained several

sharp bends, where navigation was difficult, while the upper river, above Stockton, was navigable for but a few months in the year, during high-water stage, and part of that time for boats drawing not more than 2 feet of water.

The plan for improvement was adopted in 1877, and slightly modified in 1881 and 1888. It had for its object to secure and maintain, by dredging, a channel 9 feet deep at low water, and 100 feet wide through the tidal portions of the river and Stockton Slough to Stockton, and a channel in Mormon Slough, 4 feet deep at low water and 100 feet wide, to Miller's warehouse; also temporary improvement of the low-water channel of the upper river by dredging, scraping, removal of snags, and the closure of Paradise Cut and Laird Slough.

The amount expended on the improvement of this river to June 30, 1897, was $362,753.87.

The following results were obtained to June 30, 1897: Dredging under the approved project was commenced in 1877, and has been carried on each year during the low-water stage of the river. It has given a good low-water channel 9 feet in depth to Stockton. The river has also been straightened by 3 cut-offs near Devils Elbow, 1 at Head Reach, a double cut-off in the narrows below Stockton, and a double cut-off at Twenty-one Mile Slough. The cut-offs made have shortened the distance to Stockton 4½ miles; all have been self-maintaining. The cuts at Head Reach and Twenty-one Mile Slough were not completed to full width. Paradise Cut was closed by a dam in 1888, which has since been rebuilt and kept in repair. A dam across Laird Slough was built in 1891, and has since been partly rebuilt and kept in repair.

The amount expended on this river during the fiscal year ending June 30, 1898, was $21,670.71, making the total amount thus far expended on its improvement $384,422.58.

During the past fiscal year a channel of the required depth to Stockton has been maintained by dredging; a bad sand bar which formed at Grayson in the upper river was removed by a wing dam, and obstructions removed from the river at Morrison Bend and Bells Landing by blasting. The cut-offs at Head Reach and Twenty-one Mile Slough were dredged out to the full width and depth, and are now completed.

Commerce on the river is large, important, and increasing. It is carried on 12 steamers, averaging 550 tons each; 14 barges, averaging at least 100 tons each, and several scow schooners. The commerce of the San Joaquin River during 1897 amounted to 454,955 tons, of which there was carried on the lower river 440,864 tons and 112,039 passengers.

The amount required for the completion of the existing project is indeterminate.

The State of California, by its legislature, has appropriated $300,000 for drainage, reclamation, and incidentally for river improvement. The State authorities have asked the Secretary of War for permission to make, at State expense, three additional cut-offs in this river below Stockton, and this authority has been granted.

July 1, 1897, balance unexpended	$68,746.13
June 30, 1898, amount expended during fiscal year	21,670.71
July 1, 1898, balance unexpended	47,075.42
Amount (estimated) required for completion of existing project	(*)
Amount that can be profitably expended in fiscal year ending June 30, 1900	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix S S 2.)

* Indeterminate.

3. Mokelumne River, California.—In its original condition navigation on this river was difficult on account of numerous snags and overhanging trees, and later on because of shoaling at New Hope Landing and the growth of a point of land opposite that place which interfered with the landing of boats.

The project adopted in 1884 had for its object the removal of trees and snags obstructing navigation. The project was increased in 1892 to include dredging and the removal of the point of land opposite New Hope Landing.

Up to June 30, 1897, $17,111.66 had been expended on the improvement of this river, and nothing has been spent since. No work has been done during the year.

The commerce of this river is carried on by one steamer of 385 tons, making regular trips, and a few scow schooners running at irregular intervals. The total tonnage carried in the calendar year 1897 was 52,771 tons.

The amount required for the completion of this project is indeterminate.

July 1, 1897, balance unexpended	$888.34
July 1, 1898, balance unexpended	888.34

(See Appendix S S 3.)

4. Sacramento and Feather rivers, California.—Before improvement navigation on these rivers was difficult and dangerous above Sacramento, on account of snags, shoals, and rapids. Below Sacramento the river was deep and navigation easy. Since that time the river bed, from the mouth of the Feather down, has been in places badly filled up with mining débris.

In 1874 a project was adopted having for its object the improvement of the low-water channels of the Upper Sacramento and the Feather rivers by removing snags, scraping bars, and the construction of temporary wing dams. No attempt at permanent improvement was contemplated. In 1890 the project was increased to include the closure of Paines Break, a crevasse 1¾ miles below the city of Sacramento. In 1892 it was again increased to include the closure of Jacob Slough, a crevasse above the city of Sacramento, the treatment of the Yuba River near and above Marysville, a locality in which an enormous amount of mining débris had been deposited, and the removal of obstructions in the Lower Sacramento River.

The amount expended on these rivers to June 30, 1897, was $679,225.71.

The work to June 30, 1897, secured a low-water channel with a least depth of 7 feet from Suisun Bay to Sacramento, 4 feet from Sacramento to Butte City, 3 feet from Butte City to Tehama, and 2½ feet from Tehama to Redbluff, and, in the Feather River, 2 feet to Marysville.

The amount expended on the Sacramento and Feather rivers during the fiscal year ending June 30, 1898, has been $30,292.98, making the total amount thus far expended on the improvement of these rivers $709,518.69.

During the past fiscal year navigation has been maintained with the depths above stated.

The snag boat worked in the Sacramento River from July 1 to December 9, 1897, one hundred and sixty-two days, work being done in the Upper and Lower Sacramento rivers and Georgiana Slough. During the year 1,159 snags were removed from the river and 213 overhanging trees cut from the banks; 1,094 blasts were fired, using 4,281 pounds No. 1 dynamite. The boat ran 2,004 miles. Temporary wing dams

were built at Jennings Bar, Dover Chute, Calls Bend, Monroeville, and Sacramento, and the dam at Parrott Bend was repaired.

The survey of the Sacramento River, which had been made as far as Princeton in the previous fiscal year, was completed.

The commerce on the upper river, including the Feather, is carried on 6 steamers, averaging 133 tons, and 8 barges, averaging 600 tons. On the lower river the commerce is carried on 9 steamers, averaging 408 tons, and 22 barges, averaging 600 tons.

In addition to the balance available, $25,000 will be required to operate the snag boat so as to maintain navigation in the Sacramento and Feather rivers to June 30, 1900.

The river and harbor act of June 3, 1896, provided for the appointment of three engineer officers for the purpose of carrying on the improvement of the Sacramento and Feather rivers. As this Board has the matter of a new project for the improvement of these rivers under consideration, no estimate other than the cost of running the snag boat to June 30, 1900, is presented.

The amount required for the completion of the existing project is indeterminate.

July 1, 1897, balance unexpended	$80,774.29
June 30, 1898, amount expended during fiscal year	30,292.98
July 1, 1898, balance unexpended	50,481.31

Amount (estimated) required for completion of existing project	(*)
Amount that can be profitably expended in fiscal year ending June 30, 1900	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix S S 4.)

5. *Napa River, California.*—Napa River, before improvement, had an average low-water depth of 5 feet, with the exception of the bars, where the depth was reduced to less than 1 foot on the crests. The ordinary rise of the tide being 5 feet, there was each day a practicable depth of 6 feet, and vessels of 4 feet draft could navigate the river during that time, which, however, varied from day to day.

The approved project consists in dredging the bars between Carr Bend and Vernon Mills, in the immediate vicinity of Napa City, cutting off projecting points of land so as to obtain a channel 75 feet wide and 4 feet deep at mean low water, and removing obstructions such as snags, logs, etc.

Work upon this improvement was commenced in 1889, and in that year a channel was dredged through the different bars between Carr Bend and the highway bridge at Third street, Napa City, and the river was cleared of snags. The channel was again dredged in 1891.

Up to June 30, 1897, $21,337.30 had been spent on the improvement of this stream. No work has been done and no funds expended during the past fiscal year.

The amount of commerce reported as carried on this stream during the year 1897 was 60,900 tons.

This channel being a tidal portion of a silt-bearing stream, dredging does not form a permanent improvement; consequently the amount required for completion of existing project is indeterminate.

July 1, 1897, balance unexpended	$4,162.70
July 1, 1898, balance unexpended	4,162.70

(See Appendix S S 5.)

* Indeterminate.

6. Petaluma Creek, California.—Before improvement the channel of this creek was very crooked, and in places dry at low water, navigation depending almost entirely on the tide. Its length was then 18.5 miles.

In 1880 a project was adopted for the improvement of this creek by straightening it by cut-offs and dredging it so as to obtain a channel 50 feet wide and 3 feet deep at low water. In 1892 the project was enlarged to make the channel as deep as funds would permit.

The amount expended on this work to June 30, 1897, was $60,960.54. Nothing has been spent and no work done during the year.

The commerce of this creek is carried on one steamer of 294 tons, and several scow schooners. It consists of agricultural products and manufactured goods. The tonnage of the creek for the past year could not be obtained.

The amount required for completion of the existing project is indeterminate.

July 1, 1897, balance unexpended	$39.46
July 1, 1898, balance unexpended	39.46
Amount (estimated) required for completion of existing project	Indeterminate.
Amount that can be profitably expended in fiscal year ending June 30, 1900	4,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix S S 6.)

7. Humboldt Harbor and Bay, California.—Before improvement the harbor was obstructed by a troublesome and variable sand bar, inclosing the entrance about a mile distant. Across the submerged bar was a channel which was exceedingly shifting, uncertain, and dangerous; its low-water depth has been occasionally as much as 25 feet and frequently as little as 9 feet. The bar frequently changed in position, the greatest range being about 1½ miles. Vessels were often storm-bound in the harbor for long periods. There were also numerous shoals within the harbor close to the wharves, rendering it difficult for vessels to reach Eureka, Arcata, and Hookton, the main shipping points on the bay.

In 1881 a project for improving the inside harbor was adopted, with a view to securing, by dredging, a channel 12 feet deep and 100 feet wide to the head of Eureka wharves, and one 10 feet deep and 100 feet wide to Arcata and Hookton. This project was completed in 1884 at a cost of $80,884.69. These channels have since silted up materially and are again an impediment to navigation.

In 1882 a project was adopted for improving the entrance, with the object of increasing the depth of water over the bar, by constructing a low-tide brush and stone jetty, extending seaward from the end of the south spit for a distance of 6,000 feet. Its estimated cost was $600,000. In 1891 a Board of Engineer Officers recommended the raising of this jetty to high tide, and the addition of another, making two stone and brush jetties, nearly parallel, about 2,100 feet apart, starting from the north and south spits, respectively, and extending seaward to the 18-foot contour, with such groins as might be found necessary during the progress of the work. The north jetty was not to be begun until the completion of the south. The total cost of these jetties and the necessary bank protection was estimated at $1,715,115, in addition to the sum of $342,500, which had already been appropriated. In 1892 the project was slightly modified so as to start the north jetty from the end of the dike already built for shore protection, making that a part of the jetty.

The construction of the north jetty, so far as thought necessary to prevent erosion, without waiting for the completion of the south jetty, was also authorized. The river and harbor act of July 13, 1892, placed the improvement under the continuous-contract system.

The amount expended on this work to June 30, 1897, was $1,407,861.86, of which $80,884.69 was for dredging inside the harbor, and $1,326,977.17 for improving the entrance.

Up to June 30, 1897, the north jetty had been completed. The foundation of the south jetty had been completed to bent 341, a distance of 5,456 feet. The jetty had been raised to full height to bent 200, and to low-water mark or above to bent 258. The channel across the bar had a depth of 22 feet, and was already 1,000 feet in width.

During the fiscal year ending June 30, 1898, there was expended $246,780.99, making the total amount thus far expended $1,654,642.85.

During the past fiscal year work has been confined to the south jetty, and consisted of jetty extension and building up the partly completed portions of the work with rock, of which 134,191 tons was placed in the work during the year. At the close of the year the rock in the jetty was above low water to bent 395, thence sloping down to —18 feet at bent 423, and thence gradually sloping to the end, which is at bent 462, or 7,392 feet distant from the commencement. There is a good 23-foot channel, 1,000 feet wide, across the bar.

The commerce of this harbor is carried on by three steamers, plying regularly between San Francisco and Humboldt Bay, and numerous coasting vessels, both sail and steam. The total tonnage of vessels arriving and departing during the past year was 482,226 tons.

In compliance with requirements of joint resolution of Congress approved May 7, 1898, an estimate, amounting to $75,000, was submitted to Congress under date of June 8, 1898, for redredging a channel 200 feet in bottom width, about 8,900 feet in length, to a uniform depth of 15 feet below water surface at mean low-tide level. This estimate was printed in House Doc. No. 528, Fifty-fifth Congress, second session, and is submitted herewith as part of Appendix S S 7.

July 1, 1897, balance unexpended		$486,638.14
Amount appropriated by sundry civil act approved July 1, 1898		100,000.00
		586,638.14
June 30, 1898, amount expended during fiscal year		246,780.99
July 1, 1898, balance unexpended		339,857.15
July 1, 1898, outstanding liabilities	$50,000.00	
July 1, 1898, amount covered by uncompleted contracts	289,857.15	
		339,857.15

Amount (estimated) required for completion of existing project	143,115.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	143,115.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix S S 7.)

IMPROVEMENT OF RIVERS AND HARBORS IN OREGON, OF UPPER COLUMBIA RIVER AND TRIBUTARIES, OREGON AND WASHINGTON, AND OF CLEARWATER RIVER, IDAHO.

The works in this district were in the charge of Maj. W. L. Fisk, Corps of Engineers, to November 30, 1897; of Lieut. Col. Charles L. Potter, U. S. Volunteers, first lieutenant, Corps of Engineers, from November 30, 1897, to May 11, 1898, and in the charge of Major Fisk since May 11, 1898. Division Engineer, Col. Chas. R. Suter, Corps of Engineers.

1. Port Orford Harbor, Oregon.—The river and harbor act of August 18, 1894, provided for a survey of—

Port Orford, with a view to improving the same for shipping purposes and as a harbor of refuge, commencing at Graveyard Point and by jetty, sea wall, or other proper construction, extending southerly or southeasterly into the ocean three hundred or more feet, if necessary, and suitable for vessels of middle draft; and, secondly, if necessary, by another jetty, sea wall, or other constructive work, extending from the next high point or headland southwesterly four hundred or more feet, so as to accommodate vessels of maximum draft.

The report (Annual Report, Chief of Engineers, 1895, Part V, pp. 3491–3501) submitted in compliance with the above-quoted item stated that:

Port Orford is an open roadstead and village on the coast of Oregon, 51½ miles north of the California and Oregon boundary line.

and that:

An inspection of the maps shows that Port Orford is wide open to the sea to the southward, the direction from which come the worst storms, and that the constructions as located are nearly head on to the sea and do not provide any inclosed anchorage area. This being the case, it is certain that they do not and can not be considered as providing in the remotest degree a "harbor of refuge." Therefore this view of the proposed improvements must be entirely cast aside, and they must be considered solely in relation to their use for "shipping purposes," as mentioned in the law.

These constructions for "shipping purposes" are therefore construed to be piers or wharves, and the estimate herewith is for their construction as wharves for commercial shipping purposes.

It is also proper to add that the wharves can be used with regularity only during the summer season and when northerly weather prevails. They can not be used during the prevalence of heavy southerly winter weather. For the same reasons the wharves must be built during the summer months.

The only way that a harbor of refuge can be constructed at Port Orford is by building a breakwater approximately on the lines laid down by the engineers and Boards of Engineers who have had the matter under consideration.

The report contained an estimate of $203,366 for constructing a wharf from Graveyard Point; also an estimate for constructing the wharf from Nellys Point, "the next high point or headland southwesterly."

As between the two locations, Graveyard Point and Nellys Point, Congress appears to have favored the former, inasmuch as the river and harbor act of June 3, 1896, contained the following item:

Improving Port Orford Harbor, at Grave Yard Point, Oregon, according to plan recommended by Captain Thomas W. Symons, of the Corps of Engineers, as per House Document Numbered Three hundred and thirteen, Fifty-third Congress, third session, January thirtieth, eighteen hundred and ninety-five, to cost not to exceed two hundred and three thousand three hundred and thirty-six dollars, and the unexpended balance of the appropriation heretofore made March third, eighteen hundred and seventy-nine, for the establishment of a harbor of refuge on the Pacific coast is hereby transferred to be expended on this improvement, if in the opinion of the Secretary of War the interests of commerce demand such expenditure.

No action has been taken by the Secretary of War upon this item, and until he decides that "the interests of commerce demand such expenditure" no money is to be expended for work at this locality under the terms of the act.

The act of June 3, 1896, also provided for a survey of "Port Orford Harbor, Oregon, with estimate of cost of improvement and importance to shipping and commerce." The report submitted in compliance with this item, and printed in House Doc. No. 247, Fifty-fifth Congress, second session, and also as Appendix T T 24 of this report, was to the effect that the present shipping and commercial importance of Port Orford is utterly insignificant when considered in connection with the very large sum required to adequately protect the harbor from storms, estimated by a Board of Engineers, in report of November 19, 1890, to be $7,821,960. (Annual Report, Chief of Engineers, 1891, p. 3310.)

A history of the examinations, surveys, and reports upon the subject of the proposed improvement of Port Orford Harbor up to 1891 (since which time there has been but little change in conditions) is given in the Annual Report of the Chief of Engineers for 1891, pages 3305–3312.

July 1, 1897, balance unexpended	$140,858.52
July 1, 1898, balance unexpended	140,858.52
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	62,477.48

(See Appendix T T 1.)

2. Coquille River, Oregon (general improvement).—The original channel at the entrance to the Coquille River skirted the south headland for some distance, as shown on the map opposite page 2682 of the Annual Report of the Chief of Engineers for 1882, Part III, and was tortuous, shoal, shifting, and studded with rocks. The depth over the bar at the entrance at low tide was but about 3 feet; at mean high tide a little over 7 feet.

The original plan for improvement (report printed in the Annual Report of the Chief of Engineers for 1879, Part II, p. 1806) provided for the construction of two parallel high-tide rubblestone jetties 800 feet apart, to confine and control the incoming and outgoing waters so as to cause them to scour a channel through the sand spit on the north side of the entrance, the jetties to run out to sea a sufficient distance to maintain a channel over the bar with the least depth of 12 feet at low tide. Estimated cost, $164,200.

The law of August 11, 1888, and the law of September 19, 1890, in making appropriations for continuing the work of improvement at the entrance to the river, authorized the expenditure of $5,000 and $3,000, respectively, in removing snags in the 13 miles of the upper portion of the river between Coquille and Myrtle Point, and $6,883.90 was so expended.

In 1880 the proposed depth of 12 feet at low tide to be obtained in the new channel at the entrance to the bay was reduced to 10 feet; in 1888 it was reduced to 8 feet, and in 1891 the plan was changed to provide that the jetties should be 600 feet apart at their outer ends, instead of 800 feet.

In 1892 the estimate of cost for completing the improvement, including previous appropriations (and including the $6,883.90 expended in removing snags in the river between Coquille and Myrtle Point under the acts of Congress of August 11, 1888, and September 19, 1890), was increased from $164,200 to $285,000. (Annual Report of the Chief of Engineers for 1892, Part III, pp. 2664–2665.)

The amount expended to June 30, 1897, inclusive of the $6,883.90 expended in removing snags in the upper river, was $148,999.16, and resulted in the construction of the south jetty for the distance of 2,116½ feet, and in the construction of the north jetty for the distance of 510 feet, thereby closing up the old channel and securing a new, straight channel across the bar with a low-tide depth varying from 4 to 10 feet, this variation being due to the shifting sands which are driven in by storms. The position of the new channel and the manner in which the old channel to the south of the new channel has been filled up by the effect of the jetties are shown on the map opposite page 3324 of the Annual Report of the Chief of Engineers for 1893, Part IV.

The amount expended during the fiscal year ending June 30, 1898,

resulted in strengthening the south jetty and in extending it 270½ feet, giving it the total length of 2,387 feet. No work was done during the year on the north jetty. The work done on the south jetty during the year resulted in maintaining the depth heretofore obtained over the bar rather than in increasing it. No material increase in this depth can be secured until the north jetty is extended farther out to sea, as contemplated by the existing project.

The maximum draft that may be carried June 30, 1898, at mean low tide over the shoalest part of the locality under improvement is about 7 feet.

Commercial statistics.

	Tons.		Tons.
1879	7,000	1890	23,223
1882	6,630	1891	15,994
1883	9,438	1892	19,362
1884	13,100	1893	14,491
1885	7,649	1894	14,180
1886	9,080	1895	16,256
1887	6,631	1896	21,106
1888	29,197	1897	25,620
1889	29,309		

NOTE.—The statistics for 1895, 1896, and 1897 are for calendar years, those for years prior to 1895 for fiscal years ending June 30.

Statistics for years not named are not available.

July 1, 1897, balance unexpended	$21,000.84
June 30, 1898, amount expended during fiscal year	19,420.73
July 1, 1898, balance unexpended	1,580.11
July 1, 1898, outstanding liabilities	68.20
July 1, 1898, balance available	1,511.91

Amount (estimated) required for completion of existing project	115,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	40,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix T T 2.)

3. Coquille River, Oregon, between Coquille and Myrtle Point.—The Coquille River is formed by the North, East, Middle, and South forks, which unite in the vicinity of the town of Myrtle Point. It is a tidal river, navigable by small coasting vessels from its mouth in the Pacific Ocean up to Coquille, a distance of about 25 miles, and by river steamers from Coquille to Myrtle Point, a farther distance of about 13 miles, when not obstructed by snags and shoals.

Before improvement, however, that portion of the stream between Coquille and Myrtle Point had become so filled with snags and the natural accumulation of débris due to increased cultivation of the soil and removal of forests that the river steamers were unable to reach Myrtle Point at low summer stages and were compelled to stop during such stages at Roberts Landing, 1¾ miles below Myrtle Point.

The original project for improvement, adopted in 1892 (report printed in the Annual Report of the Chief of Engineers for 1891, Part V, pp. 3280–3283), provided for deepening the channel from Coquille to Myrtle Point to 4 feet at mean low water by removing snags and by constructing wing dams at several points to scour out shoals. The width of the improved channel was limited to 50 feet, on account of the small volume of the river. The estimated cost of the improvement was placed

at $26,000, exclusive of $6,883.90 expended under acts of Congress of August 11, 1888, and September 19, 1890.

The stream was resurveyed in 1894, and it was found that rains had caused landslides and much soil to come into the upper branches and the main stream, resulting in filling the latter with sediment in its more gently flowing portions. The river for 4½ miles below Myrtle Point was much more shallow than was the case farther down, and the conditions in the 1¾ miles between Myrtle Point and Roberts Landing were particularly bad, requiring that the waters be confined between pile dikes about 60 feet apart, or between a pile dike and a strongly revetted shore, and dredging the required channel 50 feet wide and 4 feet deep at low water, the material so dredged to be placed behind the pile dikes. The revised estimate of cost of completing the improvement, including this latter work (Annual Report, Chief of Engineers for 1895, Part V, pp. 3350–3351), was $43,176.48, which amount, with the amounts expended from the appropriations made by the acts of Congress of July 13, 1892, and August 18, 1894, brings the estimated total cost to $50,980.77.

The amount expended up to the close of the fiscal year ending June 30, 1897, $8,559.64, resulted in the removal of many snags and the construction of small wing dams at Roberts Island and Rackcliffe Bar, which afforded a temporary improvement to the navigable capacity of the stream.

The expenditures during the fiscal year ending June 30, 1898, resulted in the removal of a large number of snags, the construction of dikes and shore protection between Roberts Landing and Rackcliffe Landing, a distance of five-eights of a mile, and dredging a channel 50 feet wide and 4 feet deep through several gravel shoals between those points. At the time this work was begun, on June 18, 1897, sections of the river above Coquille were almost impassable at low tide.

At the close of operations, on October 12, 1897, the river steamers experienced no difficulty in running upstream as far as Roberts Landing, but small bars have since formed, which prevent the steamers from navigating the stream above Norway, 3 miles below Myrtle Point, excepting when the stage of water is high.

The maximum draft that may be carried June 30, 1898, at mean low tide in the 10 miles between Coquille and Norway is 4 feet, and in the 3 miles between Norway and Myrtle Point 1 foot.

Commercial statistics.

	Tons.		Tons.
1893	1,242	1896	3,205
1894	1,692	1897	4,293
1895	1,409		

NOTE.—The statistics for 1896 and 1897 are for calendar years; those for years prior to 1896 for fiscal years ending June 30.

July 1, 1897, balance unexpended	$13,440.36
June 30, 1898, amount expended during fiscal year	13,279.91
July 1, 1898, balance unexpended	160.45
July 1, 1898, outstanding liabilities	3.20
July 1, 1898, balance available	157.25
Amount (estimated) required for completion of existing project	28,980.77
Amount that can be profitably expended in fiscal year ending June 30, 1900	15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix T T 3.)

4. Entrance to Coos Bay and Harbor, Oregon.—The obstruction which originally existed at the entrance to Coos Bay consisted, first, of the exterior bar, and, second, of inner shoals formed by the sands which accumulated in the spring, summer, and autumn, during the times when the northwesterly storms prevail. Under the influence of these winds the sand spit on the north side of the entrance to the bay advanced toward the south, contracting the navigable channel under Coos Head to a very narrow width, and usually causing the outer channel to follow the west side of the sand spit in a tortuous course across the bar (see middle portion of chart opposite p. 2264 of the Annual Report of the Chief of Engineers for 1884, Part III). The low-water depth on the bar was sometimes as little as 10 feet. The mean rise of tide was 5.6 feet.

The original project for improvement, approved by the Secretary of War on November 24, 1879 (printed in the Annual Report of the Chief of Engineers for 1880, Part III, p. 2323), provided for the "construction of a jetty from a point 250 yards below the northern extremity of Fossil Point on a line toward the east end of Coos Head, this line in plan curving so as to be directed at its outer end to the head, or a little to the north of it, the structure to be of wood and stone, or stone, as may be found best." The object of this jetty was to deflect the ebb tides so as to hasten the destruction of the southerly end of the north sand spit, to prevent in the future an undue contraction of the channel at Coos Head. The estimated cost of the jetty was placed at $600,000. The position of the jetty is shown to the right on the chart opposite p. 2264 of the Annual Report of the Chief of Engineers for 1884, Part III.

The present approved project (printed in the Annual Report of the Chief of Engineers for 1890, pp. 2936–2965) provides for the construction of two high-tide rubblestone jetties, the north jetty to extend seaward from the southern end of the north sand spit and the south jetty to start from Coos Head, the two jetties to converge so that the outer entrance shall have a width of about 1,500 feet, their object being to create and maintain a low-water bar depth of at least 20 feet. The present project also provides for reclaiming the sands of the north spit so as to prevent them from being blown into the channel. The estimated cost of this improvement is $2,466,412.20, independent of the amount expended on the original project. The positions of the proposed jetties are shown in the chart opposite p. 3162 of the Annual Report of the Chief of Engineers for 1891, Part V.

The amount expended under the original project, abandoned when the present project was adopted, was $213,750, and resulted in the construction of a jetty about 1,760 feet in length, located as provided by that project, which caused a partial erosion of the southern end of the north sand spit and opened a channel over the outer bar well to the south of and deeper, wider, and less shifting than the original channel.

The amount expended under the present project up to June 30, 1897, $465,276.37, resulted in the partial enrockment of the north jetty throughout its entire projected length of 9,600 feet.

That the improvement will ultimately prove to be a very successful one from an engineering standpoint is demonstrated by the fact that a low-water channel depth on the bar varying from 18 to 22 feet was obtained with the north jetty but partially built and with nothing whatever having been done toward constructing the south jetty.

Some experiments have been made in reclaiming the sands of the north spit by planting various kinds of grasses, etc., thereon.

The amount expended during the fiscal year ending June 30, 1898, resulted in raising 4,528 feet of the outer half of the north jetty up

to high-tide level. This work served to maintain the low-water depth of from 18 to 22 feet heretofore obtained on the bar rather than to increase it.

The maximum draft that may be carried on June 30, 1898, at mean low tide over the shoalest part of the locality under improvement is about 18 feet.

Commercial statistics.

	Tons.		Tons.
1883	93,380	1893	109,044
1885	75,718	1894	109,152
1886	109,988	1895	128,544
1890	242,329	1896	144,934
1892	136,065	1897	115,896

NOTE.—The statistics for 1895, 1896, and 1897 are for calendar years; those for years prior to 1895 for fiscal years ending June 30.

Statistics for years not named are either not available or are incomplete.

July 1, 1897, balance unexpended	$59,723.63
June 30, 1898, amount expended during fiscal year	48,731.49
July 1, 1898, balance unexpended	10,992.14
July 1, 1898, outstanding liabilities	65.00
July 1, 1898, balance available	10,927.14
Amount (estimated) required for completion of existing project	1,941,412.20
Amount that can be profitably expended in fiscal year ending June 30, 1900	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix T T 4.)

5. *Harbor at Coos Bay, Oregon (dredging).*—In the upper portion of Coos Bay and its tributary sloughs are a number of shoals which interfere with low-tide navigation, the principal one being just below Marshfield, the chief town on the bay, on which there was a least low-tide depth of but 5 feet at the time of survey in 1891.

This shoal is composed of mud deposited in the sluggish waters of Isthmus Slough when Coos River is in flood, and it caused considerable annoyance, especially to the colliers, as they are compelled to wait until full high tide before they can go to and from the coal bunkers situated above Marshfield, near the mouth of Isthmus Slough. Another mud shoal, with a least low-tide depth of but 8 feet, just above the bunkers of the Oregon Coal and Navigation Company, interferes with navigation to a large sawmill at Bay City.

The project for improvement, submitted in report of survey dated May 16, 1891 (report printed in the Annual Report of the Chief of Engineers for 1891, Part V, pp. 3284–3285), contemplated the construction of a small dipper dredge boat, with two hopper scows, and dredging a channel 10 feet deep at low tide and 100 feet wide at the bottom through the Marshfield and the Isthmus Slough shoals, at an estimated cost of $27,390.

The act of Congress of August 18, 1894, appropriated $13,000 "for the construction or purchase of a dredger and operating the same in removing obstructions from and deepening the harbor of Coos Bay in front of Marshfield."

Proposals for furnishing machinery for a dipper dredge were opened on January 24, 1895, and it was found that the cost of the machinery, the expense of transporting it from place of manufacture to Coos Bay, the cost of constructing a hull upon which to mount it, and the cost of *setting it up* ready for operation would exceed the amount appropriated.

The act of Congress of June 3, 1896, appropriated $14,390, with the provision "that so much of this sum as may be necessary shall be added to the amount now on hand for the construction or purchase of a dredge and two hopper scows, and that dredging within the limit of this appropriation may be contracted for in the discretion of the Chief of Engineers, and in such portion of the bay as may be found necessary."

As the localities to be dredged were where the channel was narrow, with broad tide flats alongside, affording very easy disposition of dredged material through a pipe line, but necessitating a very long and expensive tow if a dipper dredge were used and the dredged material handled in dump scows, attention was turned to the question of building a pump dredge and the necessary pipe line instead of a dipper dredge. Investigation proved, however, that it would be practically impossible to use a pipe line without infringing upon certain patents, and the owners of these patents demanded what was considered an unreasonable sum for the right to use their type of appliances.

Under the circumstances it was considered that the best results could be obtained by entering into a contract providing for the necessary dredging, but as the law respecting the purchase or construction of a dredge and scows was considered mandatory, it was decided proper to submit the subject to Congress with the view of having the law changed so as to permit the option of contracting for the work of dredging. The necessary amendment to the original act was made by the sundry civil act approved July 1, 1898, and the work of dredging will be undertaken as soon as the necessary preliminary action to that end can be had.

The amount expended to June 30, 1897, $515.08, was for advertising for proposals and printing specifications for dredge machinery and in investigating the various types of machinery and appliances.

Nothing was expended during the fiscal year ending June 30, 1898.

Commercial statistics.—It is estimated that fully three-fourths of the total commerce of Coos Bay must pass over the Marshfield and Isthmus Slough shoals.

During the year ending December 31, 1897, which was an average one so far as commerce is concerned, the total commerce of Coos Bay was 115,896 tons, principally coal and lumber.

July 1, 1897, balance unexpended	$26,874.92
July 1, 1898, balance unexpended	26,874.92

(See Appendix T T 5.)

6. *Coos River, Oregon.*—Coos River is the principal tributary of Coos Bay, and empties into the bay at its head, opposite the town of Marshfield. At a point 5½ miles from its mouth it divides into two branches, known as the North and South forks, up each of which tidal influence extends for about 8½ miles. The stream flows through a narrow fertile valley and is the only means of transportation in that section of the country. It was originally much obstructed by snags, bowlders, and bowlder shoals.

The project adopted in 1896 (printed in the Annual Report of the Chief of Engineers for 1895, Part V, pp. 3502–3505) provides for removing snags and bowlders, cutting through bars, etc., where necessary, to secure a channel 50 feet wide throughout the 5½ miles of the main river and 8½ miles of each fork, at an estimated cost of $5,000.

The expenditures to June 30, 1897, $130, were for preliminary work.

The expenditures during the fiscal year ending June 30, 1898, resulted in obtaining the desired 50-foot channel throughout the 22½ miles cov-

ered by the project. The improvement resulting from the removal of the worst obstructions has been very satisfactory to those interested in the navigation of the stream.

On account of the near exhaustion of funds it was necessary to leave a number of the smaller snags in the stream. These could be removed in one more season's operations.

The maximum draft that may be carried on June 30, 1898, at mean low tide over the shoalest part of the location under improvement is from 2 to 3 feet.

During the calendar year 1896 the commerce on the river amounted to 13,204 tons, and in 1897, 16,534 tons.

July 1, 1897, balance unexpended	$4,870.00
June 30, 1898, amount expended during fiscal year	3,734.74
July 1, 1898, balance unexpended	1,135.26

(See Appendix T T 6.)

7. *Umpqua River, Oregon.*—This stream rises in the Cascade Mountains, near Mount Thielsen, flows westward in a tortuous course, and empties into the Pacific Ocean about 175 miles south of the mouth of the Columbia River.

A partial examination of the stream from Scottsburg, 26 miles above its mouth, up to Roseburg, about 70 or 80 miles above Scottsburg, was made in 1870, and it was found to be obstructed throughout between those points by rapids, and in some places divided at extreme low water into half a dozen or more streams, varying in width from 2 to 30 feet, separated from each other by walls of rock as high as 6 feet. (Annual Report of the Chief of Engineers for 1871, p. 909.)

The original project for improvement, adopted in 1871 (printed in the Annual Report of the Chief of Engineers for 1871, p. 909), provided for blasting and removing, at an estimated cost of $22,500, some of the principal obstructions between Scottsburg and Roseburg, to enable small steamboats to navigate that portion of the stream. The stream was improved as contemplated in the fall of 1871, but steamboating in that portion of it proved unprofitable and was discontinued. (reports printed in the Annual Report of the Chief of Engineers for 1872, pp. 986, 988–989.)

In 1885 the Secretary of War authorized the expenditure of the unexpended balance of the appropriation of $22,500, made by act of Congress of March 3, 1871, in removing some reefs near and below Scottsburg, to obtain a channel 3 feet deep at low water and 50 feet wide, for the benefit of small screw vessels plying the stream at and below Scottsburg. (Annual Report of the Chief of Engineers for 1880, Part III, pp. 2333–2336, and for 1886, Part III, p. 2006.)

The project was extended in 1890 (Annual Report of the Chief of Engineers for 1887, pp. 2499–2501; for 1889, pp. 2527–2528, and for 1890, pp. 3005–3009) to provide for removing ledges and bowlders at and below Scottsburg, to obtain a channel 50 feet wide and 4 feet deep at low water in the 26 miles from Scottsburg to the mouth of the river, at an estimated cost of $9,000, or $33,500 including previous appropriations. The revised estimate of 1894 (Annual Report of the Chief of Engineers for 1894, Part IV, pp. 2570–2571) placed the additional amount required for completing the project at $6,000, making the total estimated cost $39,500.

The expenditures to June 30, 1897, $33,529.98, resulted in improving the stream above Scottsburg under the original project, as above stated, *and in beginning* the work of making a channel 50 feet wide and 4 feet

deep at low water from Scottsburg to the mouth, as provided by the existing project.

The expenditures during the fiscal year ending June 30, 1898, resulted in the removal of 633.68 cubic yards of stone from the ledges below Scottsburg, and although the small sum available for prosecuting the work did not permit of obtaining the low-water depth of 4 feet at all points, it is believed that the channel as improved fairly meets the requirements of the present limited navigation of the stream between Scottsburg and the mouth, one small steamer of about 20 inches draft, which makes daily trips between those points, being able to transport the freight and passengers offered.

Commercial statistics.

	Tons.		Tons.
1879	9,367	1893	22,936
1881	15,233	1894	22,660
1888	21,839	1895	24,891
1890	30,427	1896	17,953
1891	34,072	1897	22,420
1892	27,165		

NOTE.—The statistics for 1896 and 1897 are for calendar years; those for years prior to 1896 for fiscal years ending June 30.

Statistics for years not named are not available.

July 1, 1897, balance unexpended	$5,970.02
June 30, 1898, amount expended during fiscal year	5,689.91
July 1, 1898, balance unexpended	280.11

(See Appendix T T 7.)

8. *Mouth of Siuslaw River, Oregon.*—The Siuslaw River enters the sea through a shifting sand beach without headland or other fixed point to mark the entrance. The channel across this outer bar has a range of about 1 mile and the depth of water on the bar varies from 5 to 12 feet at low water.

The project for improvement approved by the Secretary of War on August 4, 1891 (report printed in the Annual Report of the Chief of Engineers for 1891, Part V, pp. 3175–3182), provides for confining the outgoing and incoming waters between high-tide rubblestone jetties, so located as to direct the currents upon the ocean bar in a direction practically perpendicular to the coast, the jetties to converge until they are 600 feet apart at the crest of the bar, the north jetty to be 4,500 feet long, with an approach to a wharf located under Cannery Hill 3,000 feet long, the south jetty to be 3,200 feet long, with an approach to a wharf located opposite Cannery Hill 2,400 feet long. With these jetties it is estimated that a depth of 8 feet at low tide will be maintained upon the bar that will lie in front of the entrance. The estimated cost of the improvement is $700,000.

The charts opposite page 3174 and page 3178 of the Annual Report of the Chief of Engineers for 1891, Part V, show the positions of the proposed jetties.

The amount expended to June 30, 1897, $95,327.37, resulted in the construction of the north jetty receiving wharf, the construction of a railway trestle approach 3,029 feet long, from the receiving wharf to the root of the north jetty, and the construction of 483 feet of the north jetty.

The expenditures during the fiscal year ending June 30, 1898, resulted in extending the north jetty for the distance of 428 feet, giving it a total length of 911 feet.

Nothing has been done toward the construction of the south jetty, the project providing that the north jetty shall be constructed first.

The depth on the bar has not been materially increased since the construction of the north jetty was begun, and no permanent improvement in that respect is anticipated in advance of the further extension of the north jetty.

The maximum draft that may be carried June 30, 1898, at mean low tide, over the shoalest part of the locality under improvement is 7½ feet.

Commercial statistics.

	Tons.		Tons.
1892	2,381	1895	15,296
1893	7,000	1896	7,184
1894	8,050	1897	2,239

The statistics for 1896 and 1897 are for calendar years; the statistics for the years previous to 1896 are for fiscal years ending June 30.

July 1, 1897, balance unexpended	$26,672.63
June 30, 1898, amount expended during fiscal year	24,576.93
July 1, 1898, balance unexpended	2,095.70
July 1, 1898, outstanding liabilities	60.00
July 1, 1898, balance available	2,035.70
Amount (estimated) required for completion of existing project	578,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	30,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix T T 8.)

9. *Alsea River, Oregon.*—The 31 miles of the stream from the upper forks down to the head of tide, in which distance there is an average fall of 8 feet to the mile, was originally much obstructed by rocks and by drift collected by three small wooded islands.

The project adopted in 1896 (printed in the Annual Report of the Chief of Engineers for 1895, Part V, pp. 3505–3509) provided for improving the downstream navigation of the Alsea River at the higher stages, from the upper forks down to the head of tide, by removing the natural obstructions so that roughly constructed push boats, from 28 to 36 feet long with 6 to 8 foot beams and carrying from 10,000 to 16,000 pounds of freight each, could be taken downstream with less danger, the estimated cost of the improvement being $3,000.

The expenditures to June 30, 1897, $29.19, were for preliminaries.

The expenditures during the fiscal year ending June 30, 1898, resulted in the removal of all isolated rocks, and snags, logs, stumps, etc., that interfered with high-water navigation in the 31 miles covered by the project, and the trees and brush on the several islands were also cut close to the ground and burned, to prevent them from collecting drift.

It has been impracticable to obtain a statement of the commerce handled on this stream. It may be stated, however, that the only other means of transporting the products of the Upper Alsea Valley is by a tedious and costly haul over a rough mountain road to Corvallis, Oreg., the cost varying, with the condition of the road, from 50 cents to $1.25 per 100 pounds. The cost of transporting the products down the Alsea River in push boats (costing from $16 to $20 each, and abandoned after one trip) varies from 12½ cents to 16 cents per 100 pounds.

July 1, 1897, balance unexpended	$2,970.81
June 30, 1898, amount expended during fiscal year	1,920.19
July 1, 1898, balance unexpended	1,050.62

(See Appendix T T 9.)

10. Yaquina Bay, Oregon.—Prior to improvement the prevailing depth over the bar at the entrance to the bay varied from 7 to 8 feet at low tide, and three distinct channels existed, known as the north, middle, and south channels. The mean rise of tide was about 7 feet. The south channel was the one most used, but was rendered dangerous by the presence of rocks. The middle channel, although free of rocks, was usually the shoalest of the three and was, therefore, seldom used. The north channel, besides being long and tortuous, was so studded with rocks that it was considered unnavigable. Owing to the shifting nature of the bar, these channels were constantly changing, both in position and depth.

The act of Congress of June 14, 1880, appropriated $40,000 for the improvement of the entrance to Yaquina Bay. As this appropriation was made without a survey by the Engineer Department having been first made, the officer charged with the duty of submitting a plan for improvement was authorized to first make a careful survey of the harbor. This survey was made in August–October, 1880, and the project for improvement, dated December 11, 1880, as approved by the Secretary of War, provided for constructing a jetty on the south side of the entrance to cause the south channel to shoal up and the flow of the waters to be deflected northward so as to scour out and maintain the central channel with the least depth of 17 feet at high-tide level, the jetty to start from near low-tide line and run out to sea 2,500 feet, and to rise to 2 feet above mean low tide. The estimated cost of this jetty was placed at $465,000.

The rubblestone for the jetty was to be deposited in place from barges, and in cribs if practicable. It was found, however, that cribs could not be used, on account of the strong currents and high seas, and that the ocean swell, even in quiet weather, was too great to permit the use of barges. It was necessary, therefore, to build the jetty from the shore end by carrying the rubblestone for it out over a tramway built on piles driven along the line of the proposed jetty, and this change of method of construction necessitated the amendment, in 1882, of the project so as to provide that the enrockment of the jetty be raised to high-tide level, instead of to 2 feet above mean low-tide level. This increased the proposed length of the jetty from 2,500 feet to about 3,748 feet.

The scope of the project was extended in 1888 (printed in the Annual Report of the Chief of Engineers for 1889, Part IV, pp. 2517–2521), so as to provide for the construction of a mid-tide jetty on the north side of the entrance, running out to sea in a southwesterly direction from the headland for about 2,300 feet to a point opposite the outer end of the south jetty, so as to give an entrance width of 1,000 feet.

An estimate submitted January 13, 1890 (printed in the Annual Report of the Chief of Engineers for 1890, p. 2967), placed the cost of completing the project at about $370,000. which, with the sums previously appropriated ($385,000), brought the total estimated cost up to $755,000.

In 1892 the project was again amended (printed in the Annual Report of the Chief of Engineers for 1893, Part IV, pp. 3357–3359), so as to provide that the north jetty should be built up to full high-tide level, to force both the incoming and outgoing waters to pass entirely between the jetties, instead of permitting a portion of them to pass over the north jetty; and, also, to construct 3 groins 100 feet long and 2 groins 60 feet long, from the north side of the south jetty, to protect the latter from the encroachment and undermining action of the channel current, which was taking up a position very close to the south jetty near its outer end.

The sundry civil act of March 2, 1895, provided for the appointment of a Board, to consist of three officers of the Engineer Corps, to make an examination of the bar of the Yaquina Bay, in Oregon, with a view to a project for deeper water.

The report of the Board dated October 11, 1895 (printed in the Annual Report of the Chief of Engineers for 1896, Part V, pp. 3284–3309), was that if any further permanent deepening of the bar could be made, it would be only by extending the north jetty 2,100 feet and the south jetty 2,000 feet, the new portions of the jetties to be parallel and 1,000 feet apart, and to be built of heavy riprap brought up to the level of high tide. It was also submitted that, in the event of such further extension of the jetties, the south jetty should have on the channel side groins of riprap every 300 feet to prevent it from being undermined; that a spur 800 feet long should be built from the channel side of the present south jetty for the purpose of obtaining a greater depth of water over the inner bar that had formed in recent years, and that all projecting rocks in the path of vessels should be blasted out to the general level of the rock bottom. The cost of this additional work was estimated by the Board at $1,025,000, making the estimated total cost, including previous appropriations, $1,710,000.

The Board in its report observed that the law did not call upon it "to express any opinion as to whether a further permanent deepening of the water on the bar is practicable, or, if practicable, whether the commerce of the port, present or prospective, will justify a further expenditure." The report, therefore, was silent as to the worthiness or unworthiness of an attempt to further improve the locality at an expense to the United States of over $1,000,000.

The river and harbor act of June 3, 1896, provided for—

Improving Yaquina Bay, Oregon: Continuing improvement, twenty-five thousand dollars: *Provided*, That contracts may be entered into by the Secretary of War for such materials and work as may be necessary to complete the project as recommended by the Board of Officers of the Enginer Corps October eleventh, eighteen hundred and ninety-five, to be paid for as appropriations may from time to time be made by law, not to exceed in the aggregate one million dollars, exclusive of amount herein and heretofore appropriated.

The project of the officer in immediate charge of Yaquina Bay improvement, dated November 16, 1896, for carrying on the work under the provisions of the act of Congress of June 3, 1896, provided for entering into a continuing contract for extending the jetties, building the south jetty groins and 800-foot spur, and removing the obstructing rocks, as outlined in the report of the Board of Engineer Officers dated October 11, 1895, the north jetty to be extended first, however, inasmuch as there appeared to be a possibility that further extension of the south jetty would not be necessary. This project was submitted to the Secretary of War for approval by the Chief of Engineers on December 26, 1896. It was approved by the Secretary of War on February 15, 1898.

The expenditures up to June 30, 1897, $684,958.96, resulted in completing both jetties in accordance with the original project of 1880 and as amended in 1882, 1888, and 1892, with the exception of placing about 15,000 tons of stone on the north jetty. This work resulted in obtaining from 14 to 15 feet of water on the bar at mean lower low water (21 to 22 feet at high water, where the project called for only 17 feet), thereby completing the projects of 1880, 1882, 1888, and 1892 so far as the depth to be obtained is concerned.

The expenditures during the fiscal year ending June 30, 1898, were for caring for the work done in previous years and for the Government

plant, and in preparing specifications for extending the jetties, etc., under a continuing contract in accordance with the project approved by the Secretary of War on February 15, 1898.

The chart opposite page 2680 of the Annual Report of the Chief of Engineers for 1882, Part III, shows the positions of the three channels at the entrance to the bay at the time the survey was made in 1880. The chart opposite page 3360 of the Annual Report of the Chief of Engineers for 1893, Part IV, shows the manner in which the south channel has been completely filled up, and the middle channel developed, through the agency of the jetties.

The maximum draft that may be carried on June 30, 1898, at mean low tide, over the shoalest part of the locality under improvement is about 15 feet.

Commercial statistics.

	Tons.		Tons.
1882	1,830	1890	49,121
1883	1,580	1891	61,626
1884	3,169	1892	44,956
1885	21,012	1893	24,490
1886	42,563	1894	23,345
1887	19,605	1895	20,152
1888 *a*	270,583	1896	17,940
1889	52,946	1897	15,418

a The commerce for 1888 was principally supplies for the Oregon Pacific Railroad, then under construction.

The statistics for 1895, 1896, and 1897 are for calendar years, those for years prior to 1895 for fiscal years ending June 30.

The $400,000 given in the appended money statement as the "amount that can be profitably expended in fiscal year ending June 30, 1900," is the amount that can be expended in that year provided Congress deems that the further extension of the present jetties will result in obtaining deeper water, or that the present or prospective commerce of the section requires deeper water.

July 1, 1897, balance unexpended	$25,041.04
June 30, 1898, amount expended during fiscal year	2,420.32
July 1, 1898, balance unexpended	22,620.72
July 1, 1898, outstanding liabilities	85.33
July 1, 1898, balance available	22,535.39
Amount (estimated) required for completion of existing project	1,000,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	400,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix T T 10.)

11. Nestugga River, Oregon.—Before improvement a rocky reef on the south side of the entrance to Nestugga Bay about 100 feet long, from 24 to 30 feet wide, and rising to about the level of extreme low tide, interfered with navigation. The depth of water around the reef—from 12 feet along the seaboard side to 9 feet at the channel end and 6 feet on the upper or bay side—was sufficient for the coasting vessels which occasionally visited the river.

The project for improvement adopted in 1896 (printed in the Annual Report of the Chief of Engineers for 1895, Part V, pp. 3509–3510), provided for removing the rocky reef to the depth of 9 feet at low tide, at an estimated cost of $6,000.

The expenditures to June 30, 1897, $82.78, were for a survey of the reef, and its partial removal under a contract with Normile & Fastabend dated May 1, 1897.

The expenditures during the fiscal year ending June 30, 1898, resulted in completing the removal of the reef as provided in the project.

The maximum draft that may be carried over the reef on June 30, 1898, at mean low tide is about 9 feet.

It has been impracticable to obtain a statement of the commerce of the locality.

July 1, 1897, balance unexpended	$5,917.22
June 30, 1898, amount expended during fiscal year	5,385.10
July 1, 1898, balance unexpended	532.12

(See Appendix T T 11.)

12. Tillamook Bay and Bar, Oregon.—Tillamook Bay is an indentation of the Oregon coast, having a tidal area of about 13.5 square miles, and lies about 50 miles south of the mouth of the Columbia River.

The mean tide at this point is about 6.5 feet. At low tide the bay inside presents a succession of sand and mud flats, traversed by four channels of fair depth at the entrance, but which shoal to a low-tide depth of but 1 or 2 feet near the head of the bay. These channels are designated as follows: Bay City Channel, Garibaldi Channel, Middle Channel, and Old South Channel. The usual bar exists at the entrance to the bay, but has from 10 to 15 feet of water over it at low tide, which is sufficient for vessels that have occasion to visit the towns on the Bay City Channel and Tillamook City, on Hoquarten Slough. Kilchis River, Wilson River, Hoquarten Slough, Trask River, and Tillamook River empty into Tillamook Bay from the southeast. These streams are mountain streams in their upper portions and tidal sloughs in their lower portions. The map between pp. 3248–3249, Part V of the Annual Report of the Chief of Engineers for 1896, shows the courses of the above-named channels and streams.

Tillamook City, on Hoquarten Slough, and the principal town of the region, can be reached only by light-draft vessels at high tide, the route being by way of Garibaldi Channel to the mouth of Hoquarten Slough. The only other places of importance are on the north shore of the bay, and are reached by way of the Bay City Channel. As the only navigable connection between these two channels was originally near the entrance to the bay, vessels going to points on the north shore were compelled to retrace their course nearly to the entrance in order to proceed to Tillamook City by way of the Garibaldi Channel.

The original project adopted in 1888 (printed in the Annual Report of the Chief of Engineers for 1888, Part III, pp. 2152–2154) provided for aiding vessels to reach Tillamook City by securing a mean high-tide depth of 9 feet over Dry Stocking Bar, near the mouth of Hoquarten Slough, by means of a deflecting dike to concentrate the water and by removing snags and overhanging trees along Hoquarten Slough as far up as Tillamook City. The estimated cost of this work was placed at $5,200. This estimate was increased to $5,700 in 1890, the additional $500 being required to repair a portion of the dike constructed up to that time at Dry Stocking Bar.

The project was extended upon report of survey dated October 19, 1891 (printed in the Annual Report of the Chief of Engineers for 1892, Part III, pp. 2741–2752), to provide for cutting a navigable channel through the sand and mud flat separating Bay City Channel from Garibaldi Channel. This amended project also provided for constructing

additional dikes at various points to further aid vessels to reach Tillamook City. The estimated cost of completing the project was placed at $100,000, or $105,700 including previous appropriations.

The expenditures to June 30, 1897, $52,221.86, resulted in the cutting of a navigable channel through the sand and mud flat separating Bay City Channel from Garibaldi Channel, and in the following named work designed to increase the flow and depth of water in Garibaldi Channel and Hoquarten Slough so as to aid vessels to reach Tillamook City: The removal of snags and overhanging trees in Hoquarten Slough as far up as Tillamook City; the construction of a dike across the head of Middle Channel; a dike across lower mouth of Kilchis River; a dike across the head of Old South Channel; a dike across the lower mouth of Wilson River; a dike at Dry Stocking Bar; a dike across the head of South Fork of Trask River; a dike across North Fork of Trask River, and excavating a channel from the North Fork of Trask River to Hoquarten Slough by means of which the waters of both forks of Trask River are emptied into Hoquarten Slough above Dry Stocking Bar.

The channel dredged through the sand and mud flat separating Garibaldi and Bay City channels enables vessels to proceed directly to the head of the bay by way of Garibaldi Channel, after visiting Bay City and other points on the Bay City Channel, without having to return nearly to the entrance to the bay in order to reach the Garibaldi Channel. The several dikes constructed with the view of increasing the flow and depth of water in Garibaldi Channel and Hoquarten Slough to aid vessels to reach Tillamook City have been the means of somewhat increasing the depth as far up as Dry Stocking Bar, but it is not anticipated that full benefits in this respect will be secured until the work contemplated by the project for improvement is nearer the point of completion.

The expenditures during the fiscal year ending June 30, 1898, were for the services of a watchman and for the removal of some snags in Hoquarten Slough.

Commercial statistics.

	Tons.		Tons.
1889	3,571	1893	18,316
1890	27,427	1895	29,742
1891	28,292	1896	25,977
1892	33,220	1897	29,405

NOTE.—The statistics for 1896 and 1897 are for calendar years, those for years prior to 1896 for fiscal years ending June 30.

Statistics for years not named are not available.

July 1, 1897, balance unexpended	$1,478.14
June 30, 1898, amount expended during fiscal year	548.06
July 1, 1898, balance unexpended	930.08
Amount (estimated) required for completion of existing project	52,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix T T 12.)

13. Upper Columbia and Snake rivers, Oregon and Washington.—[This work was in the charge of Capt. Harry Taylor, Corps of Engineers, until November 30, 1897.] This designation includes the 125 miles of the Columbia River from Celilo, Oreg., up to the mouth of the Snake River, and the 150 miles of the latter stream from its mouth up to

Asotin, Wash., about 7 miles above Lewiston, Idaho. Both streams between those points were originally much obstructed by rocky bars which caused rapids, the ruling depth over many of which was from 2 to 3 feet at low water, while some were impassable at low water. These bars, together with the narrow and crooked character of the channel at many places, rendered navigation by light-draft steamboats difficult and dangerous.

The original obstructions between Celilo and Asotin are described in detail in the Annual Reports of the Chief of Engineers for 1875 (Part II, pp. 772–787) and for 1877 (Part II, pp. 1036–1041).

The present obstructions in Snake River in the 66 miles from its mouth up to Riparia, Wash., are described in report of survey printed in House Doc. No. 411, Fifty-fifth Congress, second session; also printed as Appendix T T 27 of this report.

The navigable capacity of the Columbia and Snake rivers, and also Clearwater River, Idaho (a tributary of Snake River), and the character and scope of country drained by them are shown in the Annual Reports of the Chief of Engineers for 1885 (Part III, p. 2426), for 1886 (Part III, p. 1942), and for 1894 (Part IV, p. 2664).

The condition of Snake River above Lewiston and the character of the country bordering it are described in the Annual Reports of the Chief of Engineers for 1882 (Part III, pp. 2716–2722), for 1885 (Part III, pp. 2440–2442), and for 1891 (Part V, pp. 3285–3294).

An examination of some of the principal obstructions in the upper Columbia was made as early as 1867.

The first appropriation for the improvement of the upper Columbia was made by the act of Congress of June 10, 1872.

The improvement of Snake River was added to the project by the act of Congress of August 14, 1876.

As a full and continuous survey of the two streams from Celilo to Asotin has never been made, it is impossible to state the amount that will probably be required to remove all obstructions and construct deflecting dikes where necessary to contract and deepen the water.

The expenditures to June 30, 1897, $278,231.95, resulted in removing many of the worst obstructions in both streams, in the construction of a deflecting dike at Log Cabin Rapids in Snake River, 38 miles below Lewiston, and in the partial construction of a deflecting dike at Wild Goose Island Rapids, 73 miles below Lewiston.

Although the work done has not greatly increased the depth of the streams throughout the distance from Celilo to Asotin, it has increased the depth at many points where the water was originally so shallow as to render light-draft steamboat navigation impossible at low water, and has improved the conditions at the worst points to such an extent that they are less dangerous to competent navigators who are acquainted with them. The construction of railroads along and adjacent to the Columbia and Snake rivers, and the fact that the lower portion of the Snake can be navigated during the high-water period of each spring only, has caused the steamers to abandon the streams between Celilo and Riparia. Therefore the work of improvement has, since 1882, been confined to that portion of Snake River from Riparia up to Asotin. The importance of the stream for purposes of navigation between Riparia and Asotin increases each year.

The expenditures during the fiscal year ending June 30, 1898, were for extending the deflecting dike at Wild Goose Island Rapids, and resulted in obtaining an additional depth of 1 foot in the channel at that place.

The maximum draft that may be carried on June 30, 1898, at mean low water, over the shoalest point in the Snake river in the 77 miles between Riparia and Lewiston (the points between which the two steamboats in the stream make regular trips) is about 4½ feet.

Commercial statistics.

The principal article of commerce is wheat, which is taken by two steamboats operated by the Oregon Railroad and Navigation Company, principally from points between Lewiston and Riparia, to the latter point, and then taken by rail to Portland for export to Europe. The Oregon Railroad and Navigation Company is now building another steamboat to assist in handling the wheat along Snake River.

	Tons.		Tons.
1875	18,230	1893	19,364
1879	65,975	1894	9,902
1884	30,260	1895	37,100
1891	31,400	1896	25,977
1892	19,167		

NOTE.—The statistics for 1896 are for the calendar year, those for years prior to 1896 for fiscal years ending June 30. Statistics for years not named are not available.

July 1, 1897, balance unexpended	$2,768.05
December 30, 1897, reimbursement for property transferred	414.00
	3,182.05
June 30, 1898, amount expended during fiscal year	2,461.38
July 1, 1898, balance unexpended	720.67

Amount (estimated) required for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix T T 13.)

14. Columbia River at Three-mile Rapids, and the construction and equipment of a boat railway from the foot of The Dalles Rapids to the head of Celilo Falls, Oregon and Washington.—Vessels drawing 20 or more feet of water easily ascend the Columbia River from its mouth in the Pacific Ocean to a point 2½ miles below Vancouver, Wash., or a distance of about 100 miles, and river steamers drawing about 8 feet of water navigate the stream to The Dalles, Oreg., a farther distance of about 110 miles. Near The Dalles navigation is completely obstructed at all times, viz, in the distance of 12 miles are Three-mile Rapids; a crooked channel 1,500 feet in length, narrow and much obstructed by rocks and currents; then Five-mile Rapids (The Dalles) where for a mile and a half the river rushes with great velocity between precipitous walls of basalt 150 to 300 feet apart; then Ten-mile Rapids, a similar gorge one-half mile in length, and, last, Celilo Falls, with a sheer fall of 20 feet. In these 12 miles the total fall in the stream at low water is about 80 feet. The navigable capacity of the Columbia above Celilo Falls, as well as that of the Snake and Clearwater rivers, and the character of the country which would be benefited by any improvement that would enable steamers to pass the obstructions in the 12 miles of the Columbia from Three-mile Rapids up to Celilo Falls, are described in the Annual Reports of the Chief of Engineers for 1885 (Part III, p. 2426), for 1886 (Part III, p. 1942), and for 1894 (Part IV, p. 2664).

The project for providing means for boats to pass the obstructions in the Columbia between Three-mile Rapids and Celilo Falls, adopted in 1894 (printed in the Annual Report of the Chief of Engineers for 1894,

Part IV, pp. 2664–2680), as outlined in the act of Congress of August 18, 1894, is as follows:

Improving Columbia River, Oregon and Washington, at Three-Mile Rapids, and the construction and equipment of a boat railway from the foot of The Dalles Rapids to the head of Celilo Falls, said boat railway to be provided at each terminus with hydraulic lifts, and other necessary appliances, for the purposes of raising and lowering the boats on suitable cars to and from its tracks, the whole to be located, constructed, and equipped for the passage of eight boats of six hundred tons each in each direction in twelve hours, on the south side of the Columbia River, substantially in accordance with the location and plans submitted by the Board of Engineers, appointed by the President in pursuance of the provisions of the act of Congress approved July thirteenth, eighteen hundred and ninety-two.

The estimated cost of the proposed boat railway is $2,264,467.

The line of the proposed boat railway is shown on the map opposite page 3590 of the Annual Report of the Chief of Engineers for 1895, Part V.

The expenditures to June 30, 1897, $11,182.40, resulted in a survey of the line of the proposed boat railway, in obtaining title to the greater part of the land required for right of way and terminal facilities, and in partially preparing plans for the railway and its appurtenances.

The expenditures during the fiscal year ending June 30, 1898, were in payment for land and in continuing the preparation of plans for the railway.

July 1, 1897, balance unexpended	$238,817.60
June 30, 1898, amount expended during fiscal year	4,416.22
July 1, 1898, balance unexpended	234,401.38
July 1, 1898, outstanding liabilities	19.95
July 1, 1898, balance available	234,381.43
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	*2,014,467.00

(See Appendix T T 14.)

15. Canal at the Cascades, Columbia River, Oregon.—The waters of the Columbia River pass through the Cascade Mountain Range in a narrow rocky gorge about 4½ miles in length, known as the "Cascades." In the upper 2,500 feet of this gorge there is a fall of about 24 feet at low water, which completely obstructed navigation. Throughout the lower portion of the gorge the channel was much obstructed by large bowlders, rocks, and reefs, and the slope of the river was so great and its width so contracted that rapids were formed which were navigable only during the lower stages.

The scope and character of the country drained by the Columbia River, and the benefits which would accrue to it from the improvement of the upper portion of the stream for purposes of navigation, are cited in the Annual Reports of the Chief of Engineers for 1885 (Part III, p. 2426) and for 1886 (Part III, p. 1942).

The difficulties encountered in preparing definite and detailed plans for improving the locality known as the "Cascades" are described as follows in the report of a Board of Engineer Officers (printed in the Annual Report of the Chief of Engineers for 1895, Part V, p. 3577):

The work to surmount the Cascades of the Columbia River has no counterpart. It is also without precedent in the conditions surrounding it. At its inception and during its progress the conditions to be met were unknown, but by observations are gradually being revealed.

*Erroneously given as $2,114,467 in last Annual Report.

When the work of improvement began no records or observations existed giving information with reference to the physics and hydraulics of the Columbia River, or its capacity for navigation; nothing was known as to the phenomena accompanying the various phases of floods at the Cascades, such as the variations in the differences in level at head and foot of rapids during the progress of floods. No record existed of the heights of water at extreme stages, so essential in planning a work subject to such contingencies and dangers.

The original project for improvement (report of Board of Engineer Officers, printed in the Annual Report of the Chief of Engineers for 1878, Part II, pp. 1333–1344) provided for a lockage around the upper (principal) rapid at the Cascades, at all stages, by means of a canal on the Oregon shore about 3,000 feet long, and two locks (combined) 300 feet by 70 feet, with 14 and 12 foot lifts and an extreme low-water draft of 8 feet.

It being considered that boats could not navigate the rapids below the proposed canal during high stages, the project was modified in 1880 (report of Board of Engineer Officers printed in the Annual Report of the Chief of Engineers for 1881, Part III, pp. 2570–2582) to secure navigation through the canal at all stages up to 20 feet only, above low water at the foot of the upper rapids by constructing a single lock 462 feet by 90 feet with a lift of about 24 feet, and a guard gate at the head of the canal 462 feet above the upper lock gate to exclude the high water, future work to be conducted, however, with the view of making the canal available for use at stages higher than 20 feet above low water at the foot of the upper rapids should it be found later on that the improvement of the rapids below the canal permitted boats to reach the canal during higher stages. This modification also provided for improving the rapids below the canal by removing the obstructing rocks and reefs.

The original plans provided for wooden guard and lock gates. In 1888 the plans were changed to provide for steel gates (report of Board of Engineer Officers printed in the Annual Report of the Chief of Engineers for 1889, Part IV, pp. 2551–2559).

The improvement of the rapids below the canal, under the modified project of 1880, having resulted in demonstrating that they could be navigated at much higher stages than 20 feet above low water at the foot of the upper rapids, the project was again modified in 1894 (report of Board of Engineer Officers printed in the Annual Report of the Chief of Engineers for 1895, Part V, pp. 3571–3582) to provide for utilizing that portion of the canal between the upper gates of the lock and the upper guard gate as a second lock by putting in a concrete floor and side walls, thus making the canal available for use during all stages up to 42 feet above low water at the foot of the upper rapids. This modification also provided for raising the protection works of the canal, the height of which had been based on the flood of 1876, the highest water known previous to 1894, to make them conform to the flood height of the latter year, which was 6 feet above that of 1876.

There has been $3,673,000 appropriated for this work, and the amount (estimated) required for its completion is $334,260, thus making the total estimated cost $4,007,260.

The location of the canal and locks, and the rapids and contracted condition of the stream opposite and below the canal, are shown on the chart opposite page 2247 of the Annual Report of the Chief of Engineers for 1884, Part III.

The expenditures up to June 30, 1897, $3,469,154.71, resulted in the construction of the canal and locks up to a point which permitted navigation through them, and in removing many of the obstructions in the

rapids below them. Although in an incomplete state, the works were opened to navigation on November 5, 1896, and have been used since that time, excepting when high water made it impossible.

The expenditures during the fiscal year ending June 30, 1898, were in payment of liabilities incurred during the previous year, and in quarrying stone and using same in revetting the north slope of the embankment separating the canal and the Columbia River. This portion of the work has now reached the point of safety against damage by floods of the height of the one of 1894.

Vessels drawing 20 or more feet of water ascend the Columbia River from its mouth in the Pacific Ocean up to a point 2½ miles below Vancouver, Wash., or a distance of about 100 miles, and the canal and locks at the Cascades, together with the improved condition of the rapids immediately below the canal and locks, afford means for steamers drawing 8 feet of water to run up to The Dalles, Oreg., a farther distance of about 110 miles, at all stages up to 42 feet above low water as shown on the lower gauge at the canal.

Commercial statistics.—During the fiscal year ending June 30, 1898, 740 steamboats, etc., passed through the canal and locks, carrying 18,812.68 tons of freight and 30,327 passengers.

July 1, 1897, balance unexpended	$203,845.29
June 30, 1898, amount expended during fiscal year	183,138.86
July 1, 1898, balance unexpended	20,706.43
July 1, 1898, outstanding liabilities	576.80
July 1, 1898, balance available	20,129.63

Amount (estimated) required for completion of existing project	334,260.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix T T 15.)

16. Operating and care of canal and locks at the Cascades of the Columbia River, Oregon.—The obstructions existing in the Columbia River at the Cascades are described in the preceding report. The canal and locks which pass steamers around these obstructions were opened to navigation on November 5, 1896, although incomplete in many details, and have been in condition to be used ever since that date.

The expenditures up to June 30, 1897, $2,434.72, were in payment of salaries of employees engaged in operating and caring for the canal and locks, and for materials required for ordinary repairs.

The expenditures during the fiscal year ending June 30, 1898, $4,533.79, were in payment of salaries of employees engaged in operating and caring for the canal and locks, in dredging deposit from the lower entrance to the canal, and in designing, constructing, and placing bulkheads at all the openings in the main culvert on the south side of the lower lock, pumping out the culvert, and removing the valve, the disabled condition of which was mentioned in the last Annual Report (p. 3423).

Before the canal and locks were open to navigation it was necessary to transfer freight around the Cascades. Vessels drawing 20 or more feet of water ascend the Columbia for the distance of about 103 miles above its mouth in the Pacific Ocean, and the canal and locks around the obstructions at the Cascades permit steamers drawing 8 feet of water to reach The Dalles, Oreg., a farther distance of about 110 miles.

Commercial statistics.—During the fiscal year ending June 30, 1898,

740 steamboats, etc., passed through the canal and locks, carrying 18,812.68 tons of freight and 30,327 passengers.

(See Appendix T T 16.)

17. Columbia River between Vancouver, Wash., and the mouth of Willamette River.—The city of Vancouver, Wash., is located on the Columbia River, 103 miles above its mouth in the Pacific Ocean and 5 miles above the mouth of the Willamette River in the Columbia.

Vessels drawing 20 or more feet of water can easily ascend the Columbia from its mouth up to a point 2½ miles below Vancouver, where a bar with but 9 feet of water over it is encountered. After passing this bar a channel 20 or more feet deep is again found, which extends above the limits of Vancouver. This bar is evidently due to the fact that at low water about 36 per cent of the volume of the Columbia River passes south of Hayden Island, opposite Vancouver.

The project adopted in 1892 (printed in the Annual Report of the Chief of Engineers for 1892, Part III, pp. 2865–2869) provided for constructing a pile, brush, and stone dam about 3,000 feet long from the Oregon shore to the head of Hayden Island to stop the flow south of the island during low-water stages and deflect it down the main channel north of the island so as to scour the bar below Vancouver and obtain a depth over it sufficient to permit vessels drawing 20 or more feet to reach Vancouver. The estimated cost of the improvement was $33,000.

During the spring of 1893, after all but 60 feet of the dam next Hayden Island had been completed, high water submerged the dam and the island. When the water receded it was found that the head of the island and a portion of the dam had been carried away.

A special report (printed in the Annual Report of the Chief of Engineers for 1896, Part V, pp. 3264–3265) submitted in compliance with Senate resolution of December 24, 1895, stated that $67,000 in addition to the $33,000 previously appropriated would be required to rebuild and complete the dam, and to dredge the bar should it be found necessary to supplement the effect of the dam by dredging.

The expenditures to June 30, 1897 ($32,994.80), resulted in the construction of all but 60 feet of the dam, as above stated.

The expenditures during the fiscal year ending June 30, 1898, resulted in completing the work of rebuilding and extending the dam. The top of the portion of the dam next the Oregon shore, built in 1892–93, is about 4 feet above low water, while the new portion, completed during the past year, is about 6 feet above low water.

The new work was completed on April 9, 1898, but as the usual summer rise in the Columbia followed immediately, and has since prevailed, it has not been possible to make examinations to ascertain what effect the dam has had toward scouring the bar in the main channel below Vancouver.

Commercial statistics.

Calendar year—	Tons.	Calendar year—	Tons.
1893	56,346	1896	45,595
1894	62,837	1897	122,394
1895	173,992		

July 1, 1897, balance unexpended	$67,005.20
June 30, 1898, amount expended during fiscal year	25,208.83
July 1, 1898, balance unexpended	41,796.37
July 1, 1898, outstanding liabilities	19.80
July 1, 1898, balance available	41,776.57

(See Appendix T T 17.)

18. Clearwater River, Idaho.—[This work was in the charge of Capt. Harry Taylor, Corps of Engineers, until November 30, 1897.] An examination of this stream from a point on the South Fork, near Mount Idaho, to its mouth in the Snake River, at Lewiston, Idaho, a distance of about 84 miles, made in the fall of 1878, developed the fact that the 40 miles of the stream next above Lewiston was the only portion that could be improved without the expenditure of a much greater sum than was warranted by the commerce of the region. The stream, even in the 40 miles next above Lewiston, was much obstructed by rapids, shoals, rocks, etc., and the original project, adopted in 1879, provided for obtaining a low-water depth of 4½ feet, and a navigable width there for small steamers, by removing the natural obstructions, at an estimated cost of $34,424. (Annual Report, Chief of Engineers for 1879, Part II, p. 1855.)

Another examination of the stream was made in 1883, and a revised estimate (printed in the Annual Report of the Chief of Engineers for 1884, Part III, p. 2280) placed the cost of completing the work at $87,000, in addition to $15,000 previously appropriated.

No appropriations having been made from August 2, 1882, to June 3, 1896, operations were abandoned.

The act of Congress of June 3, 1896, appropriated $25,000 for "continuing the improvement of Clearwater River." A complete survey from the junction of the Middle and South forks down to Lewiston was made in the fall of 1896, and as the result of the information obtained by this survey the project for obtaining a low-water navigation was abandoned, and, instead, a project for obtaining a high-water navigation, at an estimated cost of $35,000, exclusive of the $15,000 expended under the former project and including the $25,000 appropriated June 3, 1896, was adopted.

The expenditures to June 30, 1897, $22,170.83, resulted in the partial removal of obstructing rocks, under the original project for low-water navigation, and in beginning the work of removing rocks under the present project for high-water navigation.

During the fiscal year ending June 30, 1898, the river was gone over from Kamiah, Idaho, about 67 miles above Lewiston, down to "Big Eddy," about 27 miles above Lewiston, and many rocks were blasted and removed. The rocks formerly at Big Eddy formed one of the most dangerous obstructions in the stream, and their removal has been of much benefit to navigation.

Commercial statistics.—The principal article of commerce is wheat, which is taken, during periods of high water, by two steamboats operated by the Oregon Railroad and Navigation Company, principally from points along the 30 or 40 miles of the river immediately above Lewiston, down to Riparia, on Snake River, 77 miles below Lewiston, where it is shipped by rail to Portland for export to Europe.

July 1, 1897, balance unexpended	$17,829.17
December 30, 1897, reimbursement for property transferred	2.00
March 23, 1898, refundment of overpayment	.50
	17,831.67
June 30, 1898, amount expended during fiscal year	14,380.18
July 1, 1898, balance unexpended	3,451.49
July 1, 1898, outstanding liabilities	73.88
July 1, 1898, balance available	3,377.61
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix T T 18.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examinations and surveys of the following localities required by the act of June 3, 1896, were made by the local engineer, and reports thereon submitted:

1. Preliminary examination of Umpqua River, bar, and entrance, Oregon.—Maj. W. L. Fisk, Corps of Engineers, submitted report dated August 28, 1897. The harbor throat proper has a minimum depth of about 30 feet and width of 900 feet at low tide; the average depth on the crest of the bar is seldom less than 13 feet at low water or 19 feet at high water, and no serious obstructions to navigation exist.

Major Fisk states that any plan with a view to deepening the channel over the bar must of necessity include the construction of at least one high-tide jetty a mile or more in length, and the expenditure this would involve does not seem warranted. He believes that the excellent natural conditions of this entrance together with the continued good depth upon the bar are sufficient for the needs of commerce for some time to come, in consideration of which the harbor is deemed by him to be unworthy of improvement by the General Government at the present time. The views of Major Fisk are concurred in by the division engineer, Col. Chas. R. Suter, Corps of Engineers, and by the Chief of Engineers.

The report was transmitted to Congress and printed in House Doc. No. 122, Fifty-fifth Congress, second session. (See also Appendix T T 19.)

2. Preliminary examination of Alsea River, Oregon, from head of tide water to Upper Alsea Valley.—Major Fisk submitted report of examination October 5, 1897. The work of improving this section of the Alsea River, under an appropriation made therefor by the river and harbor act of June 3, 1896, was completed September 14, 1897, and resulted in providing a high-water boat channel varying in width from 20 to 50 feet, clear of obstructions above the plane of low water, which may be run with comparative safety on any ordinary rise, and, for the reasons given in the report, Major Fisk is of the opinion that the improvement of the river for low-water navigation and the improvement of the river above the head of tide water are not worthy of further action by the General Government.

The views of the local office are concurred in by the division engineer, Colonel Suter, and by the Chief of Engineers.

The report was transmitted to Congress and printed in House Doc. No. 111, Fifty-fifth Congress, second session. (See also Appendix T T 20.)

3. Preliminary examination of Yaquina River, Oregon, from the town of Yaquina to head of tide, including the Elk River to Sunset Quarry.—Major Fisk submitted report dated October 15, 1897. For reasons given, he is of opinion, concurred in by the division engineer, Colonel Suter, and by the Chief of Engineers, that these streams are not worthy of improvement by the General Government at the present time. The report was transmitted to Congress and printed in House Doc. No. 112, Fifty-fifth Congress, second session. (See also Appendix T T 21.)

4. Preliminary examination of the Siletz River, bar, and entrance, Oregon.—Major Fisk submitted report, dated August 27, 1897. The river is, for the most part, a shallow mountain stream, emptying into Siletz Bay near its southern end, 1¾ miles from the bay entrance. At the north side of the entrance to the bay is a ledge of soft rock, beyond which extends a sand beach 400 feet to the base of a headland. Other ledges may exist in the channel between the entrance and the bar.

Major Fisk states that any plan of improvement for widening the entrance to the bay or deepening the channel across the bar would necessarily involve the construction of at least one, and possibly two, high-tide jetties extending seaward one-fourth mile or more, and that the cost of the work would be great; and in view of the limited and uncertain benefits to be obtained, as indicated by existing and prospective conditions at this point, he is of opinion, which is concurred in by the division engineer, Colonel Suter, and by the Chief of Engineers, that the bay and entrance are unworthy of improvement by the General Government at the present time. The report was transmitted to Congress and printed in House Doc. No. 107, Fifty-fifth Congress, second session. (See also Appendix T T 22.)

5. *Preliminary examination of harbor at Cape Lookout, Oregon, with the view to the construction of a harbor of refuge, and the estimated cost thereof.*—Major Fisk submitted report dated December 17, 1897. He is of the opinion that the proposed harbor of refuge, if constructed, should be located on the north side of the cape; the estimated cost of a breakwater 6,600 feet in length, the seaward end of which to be located due north of the end of the cape and the shore end about one-fourth mile east of the end of the cape, being approximately $10,725,000.

In view of the unsuitable relative position of Cape Lookout for a harbor of refuge, the poor holding ground for anchorage afforded by the hard bottom, and the enormous cost of construction, Major Fisk is of opinion that the project is not worthy of consideration by the General Government. This opinion is concurred in by the division engineer, Colonel Suter, and by the Chief of Engineers.

The report was transmitted to Congress and printed in House Doc. No. 197, Fifty-fifth Congress, second session. (See also Appendix T T 23.)

6. *Survey of Port Orford Harbor, Oregon.*—Major Fisk submitted report January 7, 1898. The harbor has been reported upon with reference to its use as a harbor of refuge, and it is assumed the present report is intended to deal solely with the commercial side of the question.

Quoting from a previous report of January 30, 1895, by Maj. T. W. Symons, Corps of Engineers, Major Fisk gives a statement of the commerce of Port Orford in detail, and states that while there may be a little more commerce now than at the time covered by those statistics, it will be seen that it is at present utterly insignificant when considered in connection with the very large sum required to adequately protect the harbor from storms, estimated by a Board of Engineers, in report of November 19, 1890, to be $7,821,960. (See Annual Report, Chief of Engineers, 1891, p. 3310.)

It is the opinion of Captain Fisk, concurred in by the division engineer, Colonel Suter, that, for reasons stated, Port Orford Harbor is not worthy of improvement by the United States.

The report was transmitted to Congress and printed in House Doc. No. 247, Fifty-fifth Congress, second session. (See also Appendix T T 24.)

7. *Survey of Tillamook Bay, bar and entrance, Oregon.*—Major Fisk submitted report December 21, 1897. He states that—

> It is believed that the development of Tillamook Bay commerce is in no way hindered by the present condition of the bar and entrance, in that any vessel that can navigate the bay will find no difficulty in crossing the bar. The bay is being improved to as great an extent as natural circumstances will permit, and it is believed that the present efforts of the Government should be confined to this improvement, as outlined in the approved project.

The views of the local officer are concurred in by the division engineer, Colonel Suter.

The estimate of cost submitted by Major Fisk for improvement of the bar and entrance is $1,200,000.

The report was transmitted to Congress and printed in House Doc. No. 217, Fifty-fifth Congress, second session. (See also Appendix T T 25.)

8. Survey of Nehalem River (Bay), Oregon, for modified plan.—Major Fisk submitted report December 29, 1897.

A project for improvement of entrance to Nehalem Bay, which provided for the construction of two high-tide stone jetties extending seaward a sufficient distance to secure a permanent low-water depth of 8 feet on the bar, was adopted by the river and harbor act approved September 19, 1890, the sum of $10,000 being made available for commencement of jetty construction. No work was done toward carrying out the project, owing to lack of funds.

The modified plan asked for is construed by local residents to mean the construction of a single jetty, which they believe, if placed on the south side, will confine the channel to a fixed position, and a plan for such a jetty has been carefully considered by Major Fisk, but for reasons stated it is thought hardly probable that a single jetty would bring about the results desired.

A project is therefore presented which contemplates the construction of two jetties at the north location, estimated to cost, including tramways, plant, and contingencies, $610,500.

The cost of a single south jetty is estimated to be, including contingencies, plant, and tramway, $582,000.

Major Fisk states, however, that, while it is quite possible future developments may render advisable the improvement of the entrance to Nehalem Bay, it is not, in his opinion, at present worthy of improvement by the General Government, and his views are concurred in by the division engineer, Colonel Suter.

The report was transmitted to Congress and printed in House Doc. No. 236, Fifty-fifth Congress, second session. (See also Appendix T T 26.)

9. Survey of Snake River, Washington, from its mouth to Riparia.—Capt. Harry Taylor, Corps of Engineers, submitted report dated January 27, 1898.

The plan of improvement presented contemplates the removal of rock ledges and bowlders, the scraping of cobblestone bars, and the building of contraction works wherever necessary, with a view to giving a channel with a minimum depth of 5 feet at low water. The cost is estimated at $165,000, and is based upon the assumption that appropriations will be sufficient to permit of a suitable plant being provided and worked at an efficient rate.

With a free channel once obtained there will still be considerable work necessary to keep it clear of bowlders, which are annually brought down by ice and high water and lodged on shoals and rapids. It is estimated that the removal of these obstructions will require an expenditure of $3,000 every two years.

In transmitting the report to this office Captain Taylor expressed the opinion that the project submitted is the best that can be devised at the present time, but that from past experience it appears that this section of the river is particularly difficult to improve, and that at present there is practically no navigation nor local commerce to be benefited, and that no navigation can be developed as long as the Columbia River is impassable for boats at The Dalles and the other means of transportation in this section of the country remain as at present.

In forwarding the report the division engineer, Col. Chas. R. Suter,

Corps of Engineers, expressed the view that the low-water improvement of a stream with such a heavy slope, beyond the removal of rocks and bowlders, is entirely impracticable except by a more radical method than that of open-channel improvement.

The report was transmitted to Congress and printed in House Doc. No. 411, Fifty-fifth Congress, second session. (See also Appendix T T 27.)

IMPROVEMENT OF LOWER COLUMBIA RIVER, OREGON AND WASHINGTON, OF WILLAMETTE AND YAMHILL RIVERS, OREGON, AND OF COWLITZ RIVER, WASHINGTON.

This district was in charge of Maj. W. L. Fisk, Corps of Engineers, having under his immediate orders Maj. Clement A. F. Flagler, U. S. Volunteers, captain, Corps of Engineers, to December 11, 1897, and Additional Second Lieut. William D. Connor, Corps of Engineers, from September 30, 1897, to April 11, 1898. Division Engineer, Col. Chas. R. Suter, Corps of Engineers.

1. Willamette River above Portland, and Yamhill River, Oregon.—At the time of the adoption of the present project, in 1878, the mouth of the Yamhill River, 40 miles above Portland, was the head of low-water navigation on the Willamette River, with a draft of 2½ feet. Above this point the controlling depth was but 1 foot.

The project of 1878 contemplated the improvement of the Willamette River by the removal of obstructions, by bank revetment, and the construction of dikes at various shoal places.

In 1892 the project was extended to include the removal of obstructions in the Yamhill River, from its mouth to McMinnville (approved August 12, 1892), a distance of 17 miles (report of survey, Annual Report of the Chief of Engineers, 1896, p. 3309). Allotments of $3,000 and $2,000 from appropriations made by the river and harbor acts of 1892 and 1894 were made for this work, and a special allotment of $8,000 was made by the act of 1894 for revetment work at Corvallis.

The Yamhill River flows into the Willamette from the north, about 40 miles above Portland. It drains an exceedingly fertile valley, which has been settled for years. Prior to improvement the channel was obstructed by snags and rocks, which were removed under the project of 1892, and boats could then reach Dayton (about 5 miles) at all seasons on a draft of about 2½ feet. Above Dayton, and about 1 mile below Lafayette, the channel was obstructed by rapids, so that boats could reach Lafayette (9 miles) and McMinnville (about 18 miles) only during extreme high water.

The present project (Annual Report, Chief of Engineers, 1897, Part I, p. 507) proposes, and the river and harbor act of June 6, 1896, and sundry civil act of June 4, 1897, provide for the improvement of the Willamette River from Portland to Eugene by the removal of obstructions and the building of controlling works, with a view of obtaining a depth of 12 feet or more from Portland to the foot of Clackamas Rapids (11 miles); of 3 to 3½ feet thence to Corvallis (107 miles), and of from 2 to 2½ feet from Corvallis to Eugene (53 miles). Estimated cost, $131,697. On the Yamhill River the project contemplates the construction of a lock and dam near Lafayette and the removal of obstructions, to provide a draft of 3½ feet throughout the year from the mouth of the river to McMinnville. Estimated cost, $69,000.

The amount expended on this improvement to June 30, 1897, was $265,953.74; $71,373.75 of this amount was expended prior to the project of 1878, and the balance ($194,579.99) on the projects of

1878–1892, $7,382.17 being applied to the improvement of the Willamette at Corvallis, and $3,211.30 in removing obstructions from the Yamhill River under the project of 1892.

On June 30, 1897, the results that had been obtained on the Willamette were marked by improvement in depth of the channel wherever works of a permanent character had been constructed. On the Yamhill River the conditions were little changed over the improvement under project of 1892, but both the Willamette and Yamhill rivers become obstructed by snags and overhanging trees which are brought down by the annual freshet, requiring almost continual operations of a snag boat and crew to keep the channels clear.

As a result of the season's work the Willamette River is in better condition than ever before, but owing to the changeable nature of the channel and its continual cutting out and filling in of gravel it is impossible to state the maximum draft that can be carried at any particular time.

As the river falls the current increases over shoal places, the cutting process is thus concentrated to a narrower channel, and the depth in many cases is little less at low water than on a somewhat higher stage.

A contract for the completion of the lock and dam in the Yamhill River, in accordance with approved plans and specifications, was executed under date of March 11, 1898. The work is being vigorously prosecuted and will probably be completed by December 31, 1898. Two and one-half feet at low water can be carried on the Yamhill to Dayton.

Comparative statement of the tonnage carried by river boats on the Willamette River above Portland.

Calendar year.	Merchandise.	Passengers.	Calendar year.	Merchandise.	Passengers.
	Tons.	*Number.*		*Tons.*	*Number.*
1894	74,615	56,368	1896	218,480	48,465
1895	130,870	57,376	1897	186,621	87,900

July 1, 1897, balance unexpended		$182,546.26
June 30, 1898, amount expended during fiscal year		36,103.66
July 1, 1898, balance unexpended		146,442.60
July 1, 1898, outstanding liabilities	$8,520.31	
July 1, 1898, amount covered by uncompleted contracts	50,912.32	
		59,432.63
July 1, 1898, balance available		87,009.97

(See Appendix U U 1.)

2. *Columbia and Lower Willamette rivers below Portland, Oreg.*—The original condition of these rivers from Portland to the sea, covering 12 miles on the Willamette and 98 miles on the Columbia River, was such that only from 10 to 15 feet could be carried over the shoal places at low water. Numerous sand bars obstructed navigation to deep-water craft and distributed the water over an extended area, so that the greatest depth could be carried over them in only a comparatively narrow channel.

The value and the availability of this waterway for purposes of commerce is proven by the quantities of grain and produce that through it find an outlet to the markets of the world from Oregon, Washington, and Idaho. Its improvement to navigation for deep-water craft was of

the utmost importance to the entire northwest section of the country, whose inhabitants find the natural outlet for their produce through the valley of the Columbia.

The original project, adopted in 1877, for improving the channel of these rivers from Portland to the sea, contemplated increasing the depth in the shoalest places to secure a minimum depth of 20 feet at low water. In 1891 this project was extended to provide for a low-water channel depth of 25 feet from Portland to the sea, and the port of Portland, a corporation existing under the laws of the State of Oregon, was granted permission to assist in carrying it into execution.

The total amount expended by the United States on this work to June 30, 1897, was $1,103,324.29, of which amount $221,780.46 was expended prior to the adoption of the project of 1877.

As a result of the works of contraction, of bank revetment, and of dredging, the condition of the improvement on June 30, 1897, was such that, by taking advantage of the tide, a draft of 23 feet or more could be carried.

During the fiscal year 1898 operations were confined to dredging to maintain the depth previously secured and to the removal of obstructions from the channel, the funds available being insufficient for obtaining any material increase of the general depth. Total excavation made, 373,089 cubic yards.

The port of Portland has continued dredging throughout most of the year, and has built a 20-inch Bowers dredge for use in this work. The total amount excavated was 185,300 cubic yards.

The results of the season's work can not be determined until the annual rise in the Columbia, which is now on, has subsided, but it is safe to assume that a low-water draft of 23 feet can be carried by taking advantage of the tides.

The Astoria and Columbia Railroad following the south bank of the river and connecting Astoria with Portland was opened for traffic in the latter part of May, 1898.

Comparative statement of traffic.

Calendar year.	Handled by river craft.	Foreign and coastwise to and from Portland.	
		Receipts.	Shipments.
	Tons.	*Tons.*	*Tons.*
1893	1,310,866	.....	312,790
1894	1,347,155	52,272	340,792
1895	1,040,022	40,238	395,954
1896	1,129,673	49,011	329,102
1897	1,499,337	47,845	290,412

July 1, 1897, balance unexpended	$77,040.71
June 30, 1898, amount expended during fiscal year	22,379.00
July 1, 1898, balance unexpended	54,661.71
July 1, 1898, outstanding liabilities	799.00
July 1, 1898, balance available	53,862.71
Amount (estimated) required for completion of existing project	472,464.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	150,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix U U 2.)

3. Columbia River, Oregon, below Tongue Point.—This improvement covers a stretch of the river beginning just below Tongue Point and extending down along the water front of Astoria. The principal obstruction is a rocky point known as the Sylvia de Grasse Reef, about one mile below Tongue Point and around which ships are obliged to make a short turn to keep the channel and avoid striking it. The same conditions have always existed, but of late years the accumulation of sand above the reef had narrowed the channel and shortened the bend, which occasioned great inconvenience to the large-sized vessels engaged in the commerce of the Columbia River.

The original and present project, adopted in 1896 (see Annual Report of the Chief of Engineers for 1895, pp. 3605–3608 et seq.), contemplates the removal of the wreck of the *Sylvia de Grasse* and the outer portion of the ledge upon which it rests, this work to be supplemented by dredging to open a waterway in front of Astoria 25 feet deep and 250 feet wide at the bottom, in accordance with the general project for improvement of the Columbia and Lower Willamette rivers from Portland to the sea.

The estimated cost was $121,550, and the river and harbor act of June 3, 1896, authorizes the expenditure on this work of $50,000 of the balance then on hand to the credit of the mouth of the Columbia River improvement.

The amount expended on this work up to the close of the fiscal year ending June 30, 1897, was $2,781.66.

At that time the dredging had materially straightened and deepened the channel so that deep-draft vessels could pass with less delay and inconvenience; the presence of the reef, however, makes a very bad place in the channel, and its removal would be a great aid to navigation.

Dredging operations, begun in April, 1897, were continued to August of the fiscal year just closed, which resulted in leaving a channel about 250 feet wide with a least depth of 23 feet at low water.

For commercial statistics, see Columbia and Lower Willamette River report.

July 1, 1897, balance unexpended	$47,218.34
June 30, 1898, amount expended during fiscal year	5,648.64
July 1, 1898, balance unexpended	41,569.70
Amount (estimated) required for completion of existing project	71,550.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	40,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix U U 3.)

4. Mouth of Columbia River, Oregon and Washington.—Prior to commencing the work of construction in 1885, there were from one to three channels across the bar at the mouth of Columbia River, and these channels varied both in location and in depth, the latter being usually from 19 feet to 21 feet, while the location shifted through nearly 180° from Cape Disappointment to Point Adams.

The project for improvement adopted in 1884 contemplated securing a low-water channel depth of 30 feet across the bar at the mouth of the river by the construction of a jetty, to extend from the shore near Fort Stevens across Clatsop Spit in the direction of a point about 3 miles south of Cape Disappointment, the jetty to be built of rubble and random blocks of stone of large size, resting upon mattresses of brush. Estimated cost, $3,710,000.

The amount expended to June 30, 1897, was $1,961,259.99, exclusive of the sum of $50,000 authorized by the river and harbor act of June 3, 1896, to be applied below Tongue Point.

The jetty, together with its four groins, was completed in the fall of 1895. At the close of the fiscal year 1897 the channel was in nearly the same position as previously reported (Annual Report of the Chief of Engineers for 1896, p. 3251), but the 30-foot depth at mean lower low water was 2,000 feet in width.

A survey of the bar completed a few days after the close of the fiscal year shows that the channel has moved a little farther to the northward, and the least depth on the bar—29 feet—at mean lower low water is one foot less than last year; but this is not surprising, considering the very severe storms of last winter and the consequent large movement of sand from the top of Clatsop Spit, depths on its crest having increased as much as 7 feet in some places, and the increase averaging probably 4 to 5 feet. The survey also coming just as the high water of the Columbia began to fall probably developed the worst possible conditions.

For commercial statistics see Columbia and Lower Willamette River report.

July 1, 1897, balance unexpended	$14,420.01
June 30, 1898, amount expended during fiscal year	2,015.43
July 1, 1898, balance unexpended	12,404.58
July 1, 1898, outstanding liabilities	564.88
July 1, 1898, balance available	11,839.70

(See Appendix U U 4.)

5. *Cowlitz River, Washington.*—[This work was in the charge of Capt. Harry Taylor, Corps of Engineers, to November 30, 1897.] The Cowlitz River is a tributary of the Columbia River, and flows into it from the north and about 64 miles from its mouth.

Prior to improvement the ruling depth at low water to Toledo, 40 miles above the mouth, was 14 inches. The channel was narrow and tortuous and obstructed by numerous snags, drift, logs, etc. The land in the valley is extremely productive, and any improvement to the river navigation is of vast benefit to the farmers living along its banks, as they are dependent upon the river for getting their produce to market.

The original project, adopted in 1880, contemplated the removal of sand bars and other obstructions to a point about 50 miles above the mouth, at a cost of $5,000 for the first year and an annual expenditure of $2,000 for maintenance thereafter.

The amount expended up to the close of the fiscal year ending June 30, 1897, was $26,688.50.

The condition of this improvement at that time was such that boats made regular trips to Toledo, but only during the highest stages of water, and even then at infrequent times, were any trips made farther upstream.

No results in the way of increased depth were derived from the expenditures during the last fiscal year, as nothing was done but to clear the river of snags and trees.

The high water during the fall of 1897 left a bar one mile below Toledo, which has divided the channel into three parts. To this point 18 inches can be carried, but boats can pass it only on the higher stages. A permanent work is needed to confine the water to one channel, and with a little additional work on two bars below only a small yearly expenditure, in snagging, will be required to maintain a channel of 2 or 2½ feet at low water, to Taylors Landing, about 8 miles above Toledo.

Comparative statement of traffic.

Calendar year:	Tons.	Calendar year:	Tons.
1894	17,923	1896	14,776
1895	17,940	1897	17,582

This statement does not include large quantities of logs that are annually floated down this stream.

July 1, 1897, balance unexpended	$1,311.50
June 30, 1898, amount expended during fiscal year	1,227.44
July 1, 1898, balance unexpended	84.06

Amount (estimated) required for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	3,000.00

(See Appendix U U 5.)

6. *Gauging waters of Columbia River, Oregon and Washington.*—The object of this gauging is to obtain data for use in connection with the improvement of the river and to supply information to persons interested in its navigation.

The self-registering gauge was reestablished at Astoria in November, 1888. It has been in operation up to the present time, and in view of its importance as a benefit to commerce its maintenance is considered a worthy object.

The amount expended on this work to June 30, 1897, was $6,201.65.

July 1, 1897, balance unexpended	$798.35
June 30, 1898, amount expended during fiscal year	360.00
July 1, 1898, balance unexpended	438.35
July 1, 1898, outstanding liabilities	84.00
July 1, 1898, balance available	354.35

Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	1,000.00

(See Appendix U U 6.)

EXAMINATIONS AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examinations and surveys of the following localities required by the river and harbor act of June 3, 1896, were made by the local engineer, Maj. W. L. Fisk, Corps of Engineers, and reports thereon submitted.

1. *Preliminary examination of Scappoose Bay, Oregon, from its mouth to and including the lower portion of Scappoose Creek.*—Major Fisk submitted report September 28, 1897. He is of opinion, in view of the fact that the locality referred to in the act is now open to navigation by light-draft river steamers, that this condition meets the present and prospective demands of its limited commerce, and that its improvement is not a work worthy to be undertaken by the General Government. These views are concurred in by Colonel Suter, the division engineer, and by the Chief of Engineers.

The report was transmitted to Congress and printed in House Doc. No. 126, Fifty-fifth Congress, second session. (See also Appendix U U 7.)

2. *Preliminary examination of Long Tom River, Oregon, from mouth to town of Monroe.*—Major Fisk submitted report September 29, 1897. He is of opinion, because of the many shoals between Monroe and

Willamette River, that this stretch of the river is not susceptible of improvement for navigation during the low-water season, though it is thought that sufficient depth might be obtained during the winter season to accommodate the light-draft steamers of the Upper Willamette. The principal obstructions to high-water navigation below Monroe are overhanging trees, together with numerous snags and an occasional brush-covered shoal, and, in view of the comparatively small expenditure that would be required to remove these obstructions in order to afford an opportunity for shipping grain and other products during the high-water season, it is the opinion of the local officer, concurred in by the division engineer, Colonel Suter, and by the Chief of Engineers, that the locality in question is worthy of improvement by the General Government to the extent named.

The report was transmitted to Congress and printed in House Doc. No. 127, Fifty-fifth Congress, second session. (See also Appendix U U 8.)

3. Preliminary examination of the Santiam River, Oregon, from Jefferson to Willamette River.—Major Fisk submitted report October 4, 1897. It appears from this report that the river, though navigable in its natural state for several months of the year, is practically unused, but one steamboat trip being known to have been made on the river in several years. The limited commerce of the section is carried by the railroads, and there is consequently not sufficient inducement offered steamers to warrant running the river at any time. For these reasons Major Fisk is of opinion, concurred in by the division engineer, Colonel Suter, and by the Chief of Engineers, that the river is not worthy of improvement by the General Government.

The report was transmitted to Congress and printed in House Doc. No. 109, Fifty-fifth Congress, second session. (See also Appendix U U 9.)

4. Survey of Clatskanie River to town of Clatskanie, Oregon.—Major Fisk submitted report December 20, 1897. He states that navigation to the town of Clatskanie may be rendered possible at all stages of river and tide by cutting a short channel across the bend immediately below Manzanillo, and another from the bend above this point to the first bend below the town of Clatskanie, and by dredging immediately below the latter point. The cost of this improvement, giving a waterway 6 feet in depth at low water, is estimated at $13,000. In view of the large amount of commerce on the river and the small sum required to afford the desired relief, it is the opinion of the district officer, concurred in by Colonel Suter, the division engineer, that the Clatskanie River is worthy of improvement by the General Government to the extent indicated.

The report was transmitted to Congress and printed in House Doc. No. 218, Fifty-fifth Congress, second session. (See also Appendix U U 10.)

5. Survey of Willamette River opposite Salem, Oreg., with a view of ascertaining the necessity of constructing a revetment or dike to maintain the channel and to prevent the cutting of a new channel through the lowlands on the left bank.—Major Fisk submitted report October 8, 1897, and from a comparison of former maps with the present survey, together with information furnished by those who have lived in the vicinity for years, it appears that no marked change has taken place in the channel recently and that there is no present indication of change.

In the opinion of Major Fisk, concurred in by the division engineer, Colonel Suter, the construction of a revetment or dike at this point is *unnecessary*, and therefore the proposed improvement is unworthy of

consideration by the General Government at the present time. For this reason no estimate of cost of improvement is submitted.

The report was transmitted to Congress and printed in House Doc. No. 120, Fifty-fifth Congress, second session. (See also Appendix U U 11.)

6. Survey of Tualitin River, Oregon, from the town of Tualitin up to Gaston, and of the Dairy Fork up to Lousignat Lake.—Major Fisk submitted report December 20, 1897. He states that any improvement of either stream would necessarily entail the straightening of its course, and, thus increasing the low-water slope, would decrease the depth, already small, on the various shoals. The clearing of the river would also produce the same result and cause further decrease. The construction of locks and dams would therefore be necessary before navigation of the upper portion could be carried on. The estimated cost of the work which it appears necessary to carry out to secure convenient navigation is $407,000, and it is the opinion of Major Fisk, concurred in by Colonel Suter, the division engineer, that the interests involved would not justify so great an expenditure.

The report was transmitted to Congress and printed in House Doc. No. 221, Fifty-fifth Congress, second session. (See also Appendix U U 12.)

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN WASHINGTON, IDAHO, AND MONTANA.

This district was in the charge of Capt. Harry Taylor, Corps of Engineers, having under his immediate orders Lieut. Meriwether L. Walker, Corps of Engineers, to May 4 and since May 14, 1898. Division Engineer, Col. Chas. R. Suter, Corps of Engineers.

1. Willapa River and Harbor, Washington.—Willapa Harbor, formerly known as Shoalwater Bay, connects with the Pacific Ocean 28 miles to the north of the entrance to the Columbia River. The only portion of the harbor to which any consideration in the way of improvement has been given is that in the vicinity of South Bend, the principal city of the harbor, and the terminus of the railroad from the main line of the Northern Pacific at Chehalis.

South Bend is situated very near the mouth of the Willapa River. Just at the upper limits of the town the river divides itself into a main channel and a secondary channel, the latter known as Mailboat Slough. This division of the waters caused bars to form in the main channel at both the upper and lower ends of the slough. There were also several bars in the river proper between South Bend and Willapa City.

The plan of improvement adopted consists in building a dike of piles, brush, and stone across the head of Mailboat Slough, in order to concentrate the ebbing and flooding currents into the main channel, and thereby produce as great a scour as possible on the shoals at the head and foot of the slough; also to dredge a channel 100 feet wide and 8 feet deep at low water through the reef just below Willapa City, and to close Louderback Slough with a pile, brush, and stone dike with the object of compelling the currents to scour a channel through the bar in the river at its lower end. The estimated cost of the work is $31,350.

The project of August 29, 1894, also provides for cutting a channel through the log jam of North River, a tributary of Willapa Harbor, as authorized by act of August 18, 1894.

The amount expended to June 30, 1897, was $27,772.80, of which $25,272.80 had been expended on Willapa River and Harbor proper, and $2,500 on the improvement of the North River.

Up to June 30, 1897, the dike work in the river and harbor, the work

of dredging through the shoal just below Willapa City, and the contemplated work on the jam in the North River had been completed.

The amount expended during the fiscal year ending June 30, 1898, was $250, which was applied to Willapa River and Harbor proper.

The work called for by the project has all been completed. The object of the improvement, so far as to give a channel 8 feet deep at mean lower low water to Willapa City, has been practically accomplished.

The dikes at Mailboat Slough have caused a general deepening of the shoals in their vicinity of about 2 feet, so that the least depth to South Bend, the principal city on Willapa Harbor, is now 15 feet at mean lower low water.

A channel 50 feet in width has been cut through the jam on the North River.

The dikes already built will probably need some slight repairs, but the money already appropriated is sufficient to maintain the improvement. It is recommended that the balance of the appropriation, or so much thereof as may be necessary, be made available for more thoroughly clearing a channel through the North River jam.

Table of comparative statistics.

Year.	Tons.	Value.
Fiscal year:		
1894	66,908	$639,280
1895	61,858	705,570
1896	48,960	600,600
Calendar year:		
1896	27,542	351,175
1897	37,815	313,163

July 1, 1897, balance unexpended	$3,577.20
June 30, 1898, amount expended during fiscal year	250.00
July 1, 1898, balance unexpended	3,327.20

(See Appendix V V 1.)

2. *Grays Harbor and bar entrance, Washington.*—The first appropriation for this work was made in the river and harbor act of June 3, 1896.

The entrance to Grays Harbor from the Pacific Ocean lies in latitude 46° 55′ north, being 45 miles north of the mouth of the Columbia River.

The harbor has a length from east to west of 17 miles, and from north to south a maximum breadth of 14 miles. There are a number of rivers tributary to the harbor, the principal ones being the Chehalis, Satsop, Wynooche, Wishkah, Hoquiam, and Humptulips, all of which come from the east and north. There are two main channels crossing the harbor from east to west—the north and south channels—of which the north channel is the principal one, and has been improved.

A large part of the harbor is occupied with tide flats, bare at low water. The total tidal area of the harbor is estimated at 96.8 square miles. At low tide the area covered by water is estimated at 30.6 square miles, or less than one-third of the total area. The average range of the tide is 8.4 feet, with a maximum range of 12.9 feet.

The harbor throat lies between two low sandy peninsulas, which are about 12,500 feet apart, measured between high-tide lines.

Through the harbor throat there is a channel having a maximum depth of 100 feet or more. A single broad waterway extends for more than 2 miles out to sea from the harbor throat, with depths gradually diminishing to 30 feet. Between this deep waterway and the open sea lies a bar convex to the sea and connected with the sand spits on the two sides of the harbor throat.

Across the bar there is no well-defined, decided, permanent channel, but there are several variable shifting channels having depths of about 12 or 13 feet. The general average distance between the inner and outer 18-foot curve is one-half mile.

The proposed plan of improvement is to control, by means of a single jetty extending out to sea from the point on the south side of the harbor throat a distance of about 3½ miles, the ebbing and flooding waters to a sufficient extent to concentrate and direct upon the bar a much greater portion thereof than would naturally go there. It is expected that a depth of 24 feet at mean lower low water will be obtained across the bar.

The jetty is to be of rubblestone built above high-tide level. The estimated cost of the work is $1,000,000.

A full description of this work with plan is published in the Annual Report of the Chief of Engineers for 1895, pp. 3517–3528.

In accordance with the authority granted by the act of June 3, 1896, making the first appropriation for this work, it is being done under a continuing contract.

The amount expended to June 30, 1897, was $1,271.76.

At that date specifications had been prepared and advertisements issued.

Bids were received and rejected, the work readvertised, a contract made, and the work begun during the year ending June 30, 1898. A receiving wharf was built on the harbor side of the point from which the jetty projected; a trestle 7,000 feet long constructed across the sand spit from the receiving wharf to the jetty proper, and a large plant accumulated for the rapid execution of the work. No work had been done outside the high-water line on the ocean side of the point at the end of the year, and hence no results in the way of increased depth had been obtained, the depth remaining as heretofore, 12 to 13 feet at mean lower low water in a shifting channel.

It is expected that the jetty will be extended seaward between 2,000 feet and 3,000 feet during the present summer, and 8,000 feet to 10,000 feet additional next summer, and completed the year after that, or by the end of the season of 1900, provided there are funds available.

Exports and imports.

Year.	Tons.	Value.
Fiscal year:		
1893	298,236	$4,431,743
1894	302,102	3,221,500
1895	159,744	848,591
1896	227,351	1,420,055
Calendar year:		
1896	110,748	629,677
1897	150,908	1,071,747

July 1, 1897, balance unexpended		$368,728.24
June 30, 1898, amount expended during fiscal year		7,674.62
July 1, 1898, balance unexpended		361,053.62
July 1, 1898, outstanding liabilities	$2,000.00	
July 1, 1898, amount covered by uncompleted contracts	766,942.90	
		768,942.90

Amount (estimated) required for completion of existing project	630,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See appendix V V 2.)

3. Chehalis River, Washington.—The portion of the Chehalis River that it is possible to navigate is about 90 miles in length, from Claquato to its mouth. This may well be considered in three sections:

1. The tidal section, from the mouth to Montesano, a distance of 15 miles. In this portion there is about 10 feet of water at high tide.

2. From Montesano to Elma, 16 miles, the river is slightly affected by the tides and has in general sufficient depth of water for light-draft boats. But navigation is obstructed by logs and fallen trees, and in summer by a scarcity of water on the bars.

3. Above Elma the river is a succession of shoals and pools, with only 6 to 12 inches of water on the shoals during low water. This part of the river is practically blockaded with snags. With improvement this river could be navigated above Elma for perhaps four months in the year a distance of 30 miles, and occasional trips made much farther up.

The plan of improvement contemplates the removal of snags, overhanging trees, jams, drift heaps, shoals, and other obstructions to navigation which may from time to time accumulate in the portion of the river regularly used by boats.

The cost of the work is indefinite.

The amount expended to June 30, 1897, was $14,481.99, and the river from Montesano to its mouth was kept open and free from troublesome snags.

During the fiscal year ending June 30, 1898, the snags which had accumulated in the river during the preceding year were removed.

The river will be gone over and the dangerous snags removed as often as the necessity demands and funds permit.

Exports and imports.

Year.	Tons.	Value.
Fiscal year:		
1895	4,354	$233,691
Calendar year:		
1896	2,561	246,496
1897	2,401	248,387

July 1, 1897, balance unexpended	$1,518.01
June 30, 1898, amount expended during fiscal year	1,070.42
July 1, 1898, balance unexpended	447.59
July 1, 1898, outstanding liabilities	1.00
July 1, 1898, balance available	446.59

Amount (estimated) required for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1890	3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix V V 3.)

4. Puget Sound and its tributary waters, Washington.—The old title of this appropriation was "improvement of Skagit, Stillaguamish, Nooksack, Snohomish, and Snoqualmie rivers, Washington." Under date of August 4, 1892, the change to the new title was approved and all money and property on hand were transferred and thereafter accounted for under the new title.

In their original conditions the navigable streams flowing into Puget Sound carried water enough for the purpose of steamer navigation, but were obstructed by snags, fallen trees, and log jams. They were the

great highways of the country, traveling by land being almost impossible on account of the heavy timber, dense underbrush, and fallen logs.

About their mouths there are in every instance large areas of shallow water with tortuous channels, and these are often obstructed by drift. These shallows act as submerged dams to the rivers and by preventing the free outflow of their waters indirectly do great damage by inundating the lowlands through which they flow.

The plan of improvement contemplates the removal of snags, logs, trees, and other obstructions to navigation. For this purpose a snag boat with an outfit of tools and appliances has been provided. This boat passes from one river to another, doing service in each as far as the necessities of its commerce require and as the amount of the funds appropriated will admit.

With the funds that have been appropriated this snag boat and outfit have been provided, and a large number of snags, jams, overhanging trees, and other obstructions to navigation removed. The obstructions in the rivers, with those that come in with every freshet, will furnish constant employment for the snag boat for an indefinite period.

The amount expended on the project to June 30, 1897, was $113,473.87.

The snag boat had been built, operated part of the time for fourteen years, and rebuilt. The rivers had been cleared of their worst obstructions, their navigation greatly improved, and the annual season during which navigation was suspended by reason of obstructions greatly lessened.

The snag boat has been kept continuously at work during the fiscal year ending June 30, 1898, and removed during the year 8,445 snags, ranging in diameter from 8 inches to 15 feet, and having an aggregate length of 218,665 feet, and cut from the banks, where they are liable to fall into the streams and become obstructions to navigation, 1,480 trees with trunks ranging in diameter from 6 inches to 8 feet, and having an aggregate length of 128,496 feet. As a result of the snagging operations during the year, the Skagit River was kept open for navigation during the year and its navigation at all seasons greatly improved, and the navigation of the other streams, when work was done, improved.

Surveys of the Skagit, Duwamish, and Puyallup rivers were made, with a view to determine what work, other than snagging, could advantageously be done there.

The snagging operations will be continued and such other work done as appears advantageous and the funds permit.

Exports and imports.

Calendar year.	Tons.	Value.
1896	18,600	$358,600
1897	11,922	325,280

July 1, 1897, balance unexpended	$60,026.13
June 30, 1898, amount expended during fiscal year	16,182.31
July 1, 1898, balance unexpended	43,843.82
July 1, 1898, outstanding liabilities	330.00
July 1, 1898, balance available	43,513.82

Amount (estimated) required for completion of existing project	Indefinite.
Amount that can be profitably expended in fiscal year ending June 30, 1900	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix V V 4.)

5. Harbor at Olympia, Wash.—Olympia is situated at the head of Budd Inlet. The upper end of this inlet is shoal. The shoals extend from the heart of the city, at Fourth Street Bridge, for a distance of 8,750 feet, to a depth of 12 feet at low water in Budd Inlet. These shoals necessitated the building of long wharves out to deep water, the maintenance of which, due to the ravages of the teredo, was very expensive. The alternative of this, i. e., boats coming and going only at high tide, caused great inconvenience.

It is proposed by the plan of improvement adopted to dredge a channel 250 feet wide and 12 feet deep at the mean of the lower low waters from the vicinity of the Fourth Street Bridge to deep water in Budd Inlet. Near its inner end the channel is to be widened out to 500 feet, so as to provide a turning basis for boats using it.

The estimated cost of the work was $275,000.

The amount expended to June 30, 1897, was $103,925.88. The turning basin had been dredged to a depth of 10 feet at extreme low water over its entire area and the channel had been dredged its full width to a depth of 8 feet at extreme low water for a distance of 1,500 feet from the outer end and to a depth of 6 feet at extreme low water for the remainder of its length.

The exact difference between "the mean of the lower low waters," the datum of the project, and "extreme low water," the datum to which the work done has been referred, was not fixed, but observations show that "extreme low water" is very nearly 2 feet lower than "the mean of the lower low waters," so that the turning basin had been finished according to the project and the channel finished to within 2 feet of the projected depth for the remainder of its length, giving an available depth at mean lower low water of 8 feet.

Future work will depend upon the funds appropriated.

Exports and imports.

Year.	Tons.	Value.
Fiscal year—		
1893	95,011	$2,087,825
1894	55,148	421,225
1895	25,125	239,400
1896	28,480	266,700
Calendar year—		
1896	36,099	191,300
1897	29,800	430,900

July 1, 1897, balance unexpended	$3,074.12
June 30, 1898, amount expended during fiscal year	842.57
July 1, 1898, balance unexpended	2,231.55
July 1, 1898, outstanding liabilities	4.47
July 1, 1898, balance available	2,227.08
Amount (estimated) required for completion of existing project	168,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix V V 5.)

6. Waterway connecting Puget Sound with lakes Union and Washington.—The river and harbor act of September 19, 1890, contained an item directing the appointment of a Board of three officers of the Corps

of Engineers, upon whom should devolve the duty of selecting and surveying the most feasible location and of estimating the expense of constructing a ship canal to connect the waters of lakes Union, Washington, and Samamish with Puget Sound, and appropriating $10,000 for the necessary expenses.

The Board thus appointed consisted of Col. G. H. Mendell, Maj. T. H. Handbury, and Capt. (now Maj.) T. W. Symons. Their report is contained in House Ex. Doc. No. 40, Fifty-second Congress, first session, and also in Annual Report of Chief of Engineers for 1892, page 2762 et seq.

The first appropriation for this work was made in the river and harbor act of August 18, 1894.

The above-mentioned report contained a full description of the physical conditions attendant upon the project for uniting the lakes mentioned with Puget Sound, and of the plan proposed for accomplishing the same.

Briefly stated, they are as follows:

Lake Washington lies directly east of Seattle, with its longest dimension nearly parallel to Puget Sound, and 2 to 6 miles distant therefrom. It is 19 miles in length, averages about 2 miles in width, and has an area of about 38.9 square miles, or 24,900 acres, of which probably 22,000 acres covers a depth of 25 feet or more, with maximum depths of not less than 600 feet. Its outlet is at the south end.

Lake Union lies at the north end of Seattle, between Lake Washington and Puget Sound. It has an area of 1½ square miles, or 905 acres, of which 499 acres covers a depth of 25 feet or more, and has a maximum observed depth of 60 feet.

Lakes Washington and Union have no natural connecting waterway, but a small canal has been cut by private enterprise through the divide separating the two lakes at what is known as the Portage.

From Lake Union there is a small stream flowing to the head of Salmon Bay, distant from Lake Union about 1 mile. From the head of Salmon Bay to deep water in Puget Sound there is a distance of about 3 miles.

The average elevation of the surface of Lake Washington is about 7 feet above that of Lake Union, and that of Lake Union is 7.8 feet above the highest high tides in Puget Sound. The variation in the level of Lake Washington amounts to about 2.5 feet either side of the average, and in Lake Union to about 1.5 feet either side of the average. The extreme range of tide is about 18 feet.

The general project for this work contemplates the construction of a ship canal connecting lakes Union and Washington with the waters of Puget Sound through Salmon Bay.

The estimated cost of a double-track canal, with masonry locks and including the necessary right of way, was $2,900,000 by the Shilshole Bay route, or $3,500,000 by the Smiths Cove route; and of a single-track canal, with composite locks and exclusive of any right of way, was $1,781,167 by the Shilshole Bay route, or $2,316,167 by the Smiths Cove route.

Since the original estimates of the cost of this improvement were made several changes in the plan have been adopted, all of which materially affect the cost. It is probable, however, that an estimate at the present time would be less than the original maximum estimate.

No funds have been available for the preparation of plans nor for carrying on the work required before an estimate can be properly made, and so no estimate is attempted.

The amount expended to June 30, 1897, was $5,000, and at that date a cadastral survey of the right of way and overflowed lands had been made for all except the part from Smiths Cove to the head of Salmon Bay.

There was nothing expended during the fiscal year ending June 30, 1898, and no work was done by the United States. The right of way was condemned and damages assessed for part of the route by the county commissioners of King County.

Detailed plans will be prepared as soon as the money is available, and construction commenced as soon as possible.

There is at present available for expenditure on this work $170,000, but under the provisions of the act of August 18, 1894, no expenditure can be made until the entire right of way and release from all damages shall be secured free of cost to the United States. The acquisition of the right of way is in progress, but until completed to the satisfaction of the Secretary of War no detailed plans can be prepared. No estimate for additional funds for the year ending June 30, 1900, is therefore presented.

The location of the Puget Sound end of the proposed canal is left to the discretion of the Secretary of War, and April 14, 1898, he approved the conclusion of a Board of Engineers that the waterway should have its terminal point at the Sound end in what is known as Shilshole Bay.

July 1, 1897, balance unexpended	$170,000.00
July 1, 1898, balance unexpended	170,000.00

(See Appendix V V 6.)

7. *Everett Harbor, Washington.*—Everett is situated on a peninsula, one side and the end of which are bounded by the Snohomish River and the other side by the waters of Puget Sound. Of the water front on Puget Sound but a small part has deep water; the remainder fronts on the tide flats which have been formed by the Snohomish River.

A portion of the river forming the rear or fresh-water boundary of the peninsula has navigable depths sufficient for all ordinary purposes of commerce, but below this, and especially across the tide flats at the mouth, the water is shallow, and great difficulty is experienced in getting into the fresh-water river harbor back of the city.

The plan of improvement adopted for this work may be generally described as follows:

First, to excavate a harbor basin in the shallows and tide lands adjoining deep water near the river's mouth; second, to dredge a channel from this through the tide flats and the Old River mouth to deep fresh water in the Snohomish River, this channel being designed to bring fresh water to the harbor basin and to afford facilities for navigation about the peninsula and into the deep water bounding the peninsula on the east; and third, to protect and maintain this harbor and channel across the tide flats by a bulkhead interposed between them and the open waters of the sound, the bulkhead to act as a retaining wall for the material dredged from the harbor.

The estimated cost of the improvement is $372,000.

The amount expended on the project to June 30, 1897, was $29,208.23.

At that date a dike for the purpose of retaining the dredged material had been built from the lower end of Smiths Island along the established bulkhead line for a distance of 14,436 feet, and a channel, 50 feet wide at the bottom and 6 feet deep at mean low water, dredged from the deep water on the outside in toward the deep water in the river for a distance of 2,885 feet.

The amount expended on the project during the fiscal year ending June 30, 1898, was $316.50.

Sand flats, which rise some 3 feet above mean low water, extend entirely across the proposed channel so that no boats of any kind can use the channel at or near that stage.

The dike will be kept in repair and the dredging continued as funds may be available.

Exports and imports.

Year.	Tons.	Value.
Fiscal year:		
1895	79,919	$1,845,282
1896	144,541	2,724,789
Calendar year:		
1896	210,547	5,384,831
1897	74,960	2,974,526

July 1, 1897, balance unexpended	$791.77
June 30, 1898, amount expended during fiscal year	316.50
July 1, 1898, balance unexpended	475.27
July 1, 1898, outstanding liabilities	.71
July 1, 1898, balance available	474.56

Amount (estimated) required for completion of existing project	342,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

(See Appendix V V 7.)

8. *Swinomish Slough, Washington.*—Swinomish Slough is a tidal slough connecting the waters of Saratoga Passage and Skagit Bay on the south with Padilla Bay on the north. It is an important water highway, furnishing the most easterly, the shortest, and safest route for the smaller class of steamboats between the northern and southern waters of Puget Sound. It skirts the Skagit Delta, the richest and most extensive agricultural region of western Washington. It is, however, shallow and crooked in some portions, and the approaches to it are across the shallow flats of Padilla Bay on the north and Skagit Bay on the south.

Swinomish Slough is the ordinary meeting place of the tides, although at times the tides run in one direction entirely through.

The ordinary rise and fall of the tides in the slough is about 8 feet. As a general thing throughout the slough there was an abundant depth of water. Opposite La Conner there was 10 to 15 feet at low water; just south of La Conner this increased to 34 feet, while at the northern entrance to the "Hole in the Wall" there was a depth of 40 feet at low water.

Where the slough widens out, especially where the Indians have been in the habit of putting fish traps, this depth decreased, so that there was not over 2 feet at low water in any practicable channel. What channel there was was very crooked.

At the northern end the slough opens out into the flats, forming the southern portion of Padilla Bay, in the midst of diked land and marshes.

At the southern end of the slough there were two passages connecting the slough with the waters of Skagit Bay. These passages were separated by a rocky island called McGlinns Island.

The east passage was wide and shallow, having nowhere more than 2 feet depth at low water. The west passage between McGlinns and Fidalgo islands was at the narrowest place 220 feet wide, with an ample depth of water for all purposes.

This short and crooked passage was so situated with high rocky bluffs on either side that one could not see through from one end to the other. On account of its character it had received and was known by the very descriptive title of the "Hole in the Wall."

This is the passage used almost exclusively by steamers.

The plan of improvement adopted is to dredge a channel 4 feet deep and 100 feet wide from deep water in Saratoga Passage across Skagit Flats, through the shoals of the slough proper, and across the flats of Padilla Bay to deep water, and to build dikes in Skagit and Padilla bays to direct the ebbing and flooding waters through the dredged channels.

The estimated cost of this work is $122,000.

A report of a survey of Swinomish Slough upon which the plan of improvement is based is printed with a general map in House Ex. Doc. No. 31, Fifty-second Congress, first session, and reprinted without map in the Report of the Chief of Engineers for 1892, pages 2753–2762.

Maps showing parts of the improvement are also published in the Report of the Chief of Engineers for 1894 opposite page 2615, and for 1896 opposite page 3377.

The amount expended to June 30, 1897, was $72,830.25.

At that date a wattled-pile dike 6,180 feet long had been constructed from a point 400 feet west of the entrance to the "Hole in the Wall" westerly to a point 300 feet distant from the northwest point of Goat Island, a dike consisting of a single row of piles had been built between Goat and Ika islands, and a pile, brush, and stone dike 2,745 feet long had been built between McGlinns Island and Gallahers Point. The wattled dike having shown signs of weakness at exposed points, 2,129 feet of it had been strengthened by adding a second row of piles, and filling in between the two rows with brush and stone. The remainder of the dike had been thoroughly repaired. A channel 100 feet wide at the bottom and 4 feet deep at mean low water had been dredged parallel to and 75 feet from the wattled dike for a distance of 6,120 feet, and across the tide flat just inside the "Hole in the Wall" between McGlinns Island and La Conner, and from La Conner north about half way to the northern end of the slough. Boats drawing 4 feet can now reach La Conner from the south at mean low water, but not to exceed 2 feet can be carried through the slough.

A short spur was added to the dike inside the "Hole in the Wall."

Work in accordance with the project will be extended north of La Conner as fast as available funds permit.

Exports and imports.

Year.	Tons.	Value.
Fiscal year:		
1893	55,700	$1,510,000
1894	64,050	1,637,000
1895	114,917	1,713,020
1896	131,370	1,709,700
Calendar year:		
1896	65,375	1,347,664
1897	64,497	1,190,000

July 1, 1897, balance unexpended	$2,169.75
June 30, 1898, amount expended during fiscal year	2,005.61
July 1, 1898, balance unexpended	164.14
July 1, 1898, outstanding liabilities	9.00
July 1, 1898, balance available	155.14
Amount (estimated) required for completion of existing project	47,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

(See Appendix V V 8.)

9. Kootenai River, Idaho, between Bonners Ferry and the international boundary line.—The portion of the Kootenai River for which this appropriation is available is about 60 miles in length, has a gentle current, and a depth sufficient for navigation, but was obstructed by many snags which had lodged in the river.

A description of this part of the river is published in the Annual Report of the Chief of Engineers for 1893, pages 3456–3458.

The plan of improvement is to remove the snags in the river and the leaning trees on the banks which are liable to fall in and become obstructions. The estimated cost of the improvement is $5,000.

The amount expended to June 30, 1897, was $2,163.03.

The worst snags had been removed from about one-half the stretch of river to be improved.

During the fiscal year ending June 30, 1898, the entire stretch of river included within the limits of the project was gone over and all the snags in the channel cleared out.

The river will be gone over occasionally and such new snags as are found taken out as long as there are funds available.

Exports and imports.

Calendar year.	Tons.	Value.
1896	1,600	$42,815
1897	2,212	49,025

July 1, 1897, balance unexpended	$2,836.97
June 30, 1898, amount expended during fiscal year	2,091.51
July 1, 1898, balance unexpended	745.46

(See Appendix V V 9.)

10. Kootenai River, above Jennings, Mont.—The Kootenai River between Jennings and the international boundary line, a distance of 65 miles, is fairly good for purposes of navigation. At extreme low water it is obstructed at several places by shoals, over which there is not sufficient water for navigation. At the higher stages the only obstruction of any consequence was in a canyon about 5 miles above Jennings, where the rock walls of the river approach each other to such an extent as to produce a very marked damming effect upon the river, causing a heavy fall and swift currents. Large rocks were scattered about in the river and along the shores, rendering the ascent of boats difficult and the descent extremely dangerous. The best channels through the worst rocks were about 80 feet wide.

The project adopted for this improvement is to break up and remove the dangerous rocks, and by cutting off the points which produce the damming effect so to increase the channel as to reduce the velocity of the current and enable boats to navigate with greater ease and less danger.

The appropriation for this improvement was made in the deficiency appropriation act, approved July 19, 1897.

During the fiscal year ending June 30, 1898, the projecting points were cut off above the low-water line so that the width of the river at the narrowest points was increased from 150 feet at high water, its original width, to 200 feet, and the banks smoothed down so that boats can now pass this canyon with comparative safety. Previous to the passage of the appropriation under which this work was carried on the rocks in the channel had been removed to slightly below low water by private enterprise, so that at the higher stages there is now an available channel 200 feet wide where formerly the widest channel was only 80 feet.

Such rocks as may prove to be obstructions will be removed.

Of the values given below, $42,373 worth of exports and $127,548 worth of imports passed through the hands of the collector of customs, port of Greatfalls, Mont.

Three steamers plied on the river part of the year—the *North Star*, 379 tons; *Gwendoline*, 158 tons, and *Ruth*, 368 tons. The maximum draft is 3 feet 6 inches.

One thousand and eighty-seven passengers were carried.

The steamers *Gwendoline* and *Ruth* were wrecked on May 7, 1897.

No previous report of statistics has been made for this work.

Exports and imports.

Class of goods.	Exports.		Imports.	
	Quantity.	Value.	Quantity.	Value.
	Tons.		*Tons.*	
Grain	227	$6,820		
Hay	170	5,067		
Ore			2,575	$180,250
Lumber	39	337		
Miscellaneous	875	75,772		
Total	1,311	88,016	2,575	180,250

Amount appropriated by act of July 19, 1897	$5,000.00
June 30, 1898, amount expended during fiscal year	3,564.64
July 1, 1898, balance unexpended	1,435.36
July 1, 1898, outstanding liabilities	15.31
July 1, 1898, balance available	1,420.05

(See Appendix V V 10.)

11. Flathead River, Montana.—The portion of the Flathead River included within the limits for which this appropriation is available is about 27 miles in length. This portion of the river is of very gentle slope, running with many turns through a large area of low-lying lands, and has a minimum depth of about 10 feet, but is obstructed by a large number of snags which have accumulated in the river.

The plan of improvement is to remove the snags.

No estimate of the cost of this improvement has been made, and from its nature none can be made.

Nothing had been spent on this improvement up to June 30, 1897.

During the fiscal year ending June 30, 1898, the entire stretch of river within the limits of the project was worked over and a greater part of the worst snags removed.

The remainder of the snags which obstruct navigation will be removed.

The funds already appropriated are sufficient to carry on all the work necessary for the next two years.

One steamer with a draft of 3 feet is engaged in traffic on the river and lake.

Three hundred and sixty-three tons of freight, consisting of general merchandise, lumber, hay, and grain, and 282 passengers were carried between local points.

Owing to the snagging operations on the river, some 20,000 ties were run out, and this will probably constitute one of the industries of the country.

July 1, 1897, balance unexpended	$10,000.00
June 30, 1898, amount expended during fiscal year	4,471.03
July 1, 1898, balance unexpended	5,528.97
July 1, 1898, outstanding liabilities	10.00
July 1, 1898, balance available	5,518.97
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	Indefinite.

(See Appendix V V 11.)

EXAMINATION AND SURVEYS MADE IN COMPLIANCE WITH RIVER AND HARBOR ACT OF JUNE 3, 1896.

The preliminary examination and surveys of the following localities, required by the river and harbor act of June 3, 1896, were made by the local engineer, Capt. Harry Taylor, Corps of Engineers, and reports thereon submitted:

1. Preliminary examination of Neah Bay, Washington, with a view to its improvement as a harbor of refuge.—Captain Taylor submitted report of examination November 10, 1897. He states that from the conditions under which the commerce passing through the Strait of Juan de Fuca is carried on, as described in his report, and the number of wrecks which have occurred, it seems that this commerce does frequently need a harbor of refuge; that Neah Bay is the best and most suitable place for such a harbor of refuge; that in his opinion the locality is worthy of improvement "as a harbor of refuge," and that the improvement is justified by the interests of commerce involved. His views are concurred in by the division engineer, Col. Chas. R. Suter, Corps of Engineers.

It is estimated that a survey necessary for preparation of plans and estimates for improvement will cost $500, and it is the opinion of the Chief of Engineers that the conditions justify such a survey as will furnish the detailed information necessary for determining the cost of the proposed work and its relation to the interests of commerce involved.

The report was transmitted to Congress and printed in House Doc. No. 139, Fifty-fifth Congress, second session. (See also Appendix V V 12.)

2. Survey of mouth of Willapa River and Mailboat Slough, Washington.—Captain Taylor submitted report of survey August 20, 1897. The

river is obstructed by two bars between South Bend and the mouth, and the plan of improvement proposed by Captain Taylor is to dredge these two bars to a depth of 20 feet at mean lower low water, the width through the lower bar to be 200 feet and through the upper bar 100 feet. He estimates that the work proposed will cost, in round numbers, $80,000.

Captain Taylor states that, in his opinion, the proposed improvement is a worthy one, and is justified by the interests of the commerce involved, and his opinion is concurred in by the division engineer, Colonel Suter.

The report was transmitted to Congress and printed in House Doc. No. 100, Fifty-fifth Congress, second session. (See also Appendix V V 13.)

3. *Survey of Quillayute Harbor and River, Washington.*—Captain Taylor submitted report of survey November 5, 1897. The plan of improvement submitted provides for the closing of the present river mouth by means of a dike, the reopening of the old mouth, the protection of the sand spit between the existing lagoon and the ocean, and the making of a cut across the sand spit to the south of the lagoon into Quillayute Harbor. The cost of the work is estimated at $20,000.

The report was transmitted to Congress and printed in House Doc. No. 130, Fifty-fifth Congress, second session. (See also Appendix V V 14.)

4. *Survey of Deschutes River at its entrance in Olympia Harbor, Washington.*—Captain Taylor submitted report of survey July 27, 1897.

The harbor of Olympia is now being improved by the General Government in accordance with a plan which provides for dredging a channel 250 feet wide and 12 feet deep at the mean of the lower low waters from the vicinity of the Fourth Street Bridge to deep water in Budd Inlet. Provision is also made in the existing project for a turning basin near the inner end of the channel.

Two methods of improvement are suggested in the accompanying report, one by dredging a channel sufficient to accommodate shallow-draft boats, and the other to form a fresh-water harbor south of Fourth street. The former method is estimated to cost $264,000, and, Captain Taylor reports, would facilitate the export of beer and possibly in the future some other manufactures. The latter plan is estimated to cost in excess of $1,000,000, and, Captain Taylor states, might result in stimulating the lumber industry of Olympia.

In the opinion of Captain Taylor and of the division engineer, Colonel Suter, neither form of improvement is justified by the interests of commerce, nor is any improvement of the Deschutes River or Olympia Harbor, other than that which is already nearly completed, justified by the interests of commerce involved.

The report was transmitted to Congress and printed in House Doc. No. 104, Fifty-fifth Congress, second session. (See also Appendix V V 15.)

5. *Survey of mouth of Puyallup River, Washington.*—Captain Taylor submitted report of survey February 16, 1898.

One improvement desired appears to have for its object the control of the flood waters, to prevent overflow of adjacent land, and another the dredging of two waterways deep enough to accommodate ocean-going vessels, one to be called the Puyallup Waterway, the other the City or West Waterway, at Tacoma, Wash.

Captain Taylor presents a project for deepening the Puyallup Waterway to 25 feet at low water throughout its entire length and width by the removal of 3,241,400 cubic yards of material, at a cost, including bulkheading, engineering, etc., estimated, in round numbers, to be

$570,000. In his opinion the land-reclamation project should not be undertaken by the Government as part of river and harbor improvements, and no estimate is presented for the City Waterway for the reason that it is not part of the mouth of the Puyallup River at the present time.

In his letter transmitting this report Captain Taylor states that, in his opinion, the proposed improvement is not a worthy one and is not justified by the interests of the commerce involved. His views are concurred in by the division engineer, Colonel Suter.

The report was transmitted to Congress and printed in House Doc. No. 345, Fifty-fifth Congress, second session. (See also Appendix V V 16.)

6. *Survey of Duwamish River and its tributaries, Washington.*—Captain Taylor submitted report of survey March 5, 1898.

The improvement of the Duwamish River is carried on from time to time under an appropriation provided by Congress for improving Puget Sound and its tributary waters, the operations consisting of the removal of snags, logs, trees, and other obstructions to navigation. The stream is formed by the junction of the Black and White rivers, and there is at present no navigation on any of the rivers of the Duwamish system.

Captain Taylor states that any demand that there may be for the improvement of this river does not originate in a desire to increase its navigable capacity nor to improve its navigability, but in a desire to have the bottom lands along its course protected from overflow; but the conditions surrounding the Duwamish River make the problem of protecting these bottom lands from overflow an exceedingly difficult one to solve at an expense that would not be far greater than would be warranted by the present value of the lands concerned, and, in the opinion of Captain Taylor, the only possible way of affording such protection is by a complete and thorough system of dikes, but, for the reasons stated in the report, it does not appear that such work should be undertaken by the General Government.

In forwarding the report to this office the local officer expressed the opinion that the interests of the commerce involved do not justify any improvement of the Duwamish River at the present time other than a small amount of snagging, which can be done, whenever navigation so requires it, with the funds appropriated for improving Puget Sound and its tributary waters, and these views were concurred in by the division engineer, Colonel Suter.

The report was transmitted to Congress and printed in House Doc. No. 395, Fifty-fifth Congress, second session. (See also Appendix V V 17.)

7. *Survey of Skagit River from its mouth to the town of Sedro, Wash.*—Captain Taylor submitted report of survey December 11, 1897.

This river is now being improved by the United States by removing snags, etc., under appropriations for improving Puget Sound and its tributary waters, the chief obstructions to navigation being snags, which accumulate with every freshet.

Captain Taylor states that the improvement of Skagit River, which is of the greatest importance to navigation, is that which has been carried on for a number of years past, viz, removing the snags which lodge in the river channel. He has carefully considered the advantages to navigation to be derived from other methods of improvement, such as dredging, dike building, revetting banks, and straightening the river, but concludes that they are not sufficient to justify the expense.

The improvement most desired by the people living in the Skagit Valley is such as will prevent their lands being overflowed with each

freshet, by opening the various mouths of the river so as to afford free exit for the flood waters, but the evidence shown by the history of the river is that one good navigable channel may be maintained from a short distance inside the tide flats up the river to Mount Vernon, and that one channel is best, not only for navigation, but also for the protection of the farms along the river banks.

In his letter transmitting this report Captain Taylor states:

> In my opinion the continuance of the work which has heretofore been carried on in the Skagit River—that is, snagging—is of the utmost importance to the navigation of the river, and so far as this is concerned the improvement is a worthy one and justified by the interests of the commerce involved, but, for the reasons stated in the report, I am of the opinion that no further improvement is justified at the present time.

These views are concurred in by Colonel Suter, the division engineer.

The report was transmitted to Congress and printed in House Doc. No. 204, Fifty-fifth Congress, second session. (See also Appendix V V 18.)

8. Survey of Okanogan River, Washington.—Captain Taylor submitted report of survey December 18, 1897. The improvement proposed by Captain Taylor contemplates rock removal, construction of wing dams, and snagging, at an estimated cost of $30,000, to permit navigation from the mouth of the river to the international boundary line at all times of the year except during extreme low water.

In transmitting his report Captain Taylor expresses the opinion that the proposed improvement is a worthy one and is justified by the interests of commerce involved. His views are concurred in by Colonel Suter, the division engineer.

The report was transmitted to Congress and printed in House Doc. No. 211, Fifty-fifth Congress, second session. (See also Appendix V V 19.)

9. Survey of Pend Oreille River, from its source at Lake Pend Oreille, Idaho, to the town of Metalline, Wash.—Captain Taylor submitted report of survey December 28, 1897.

The upper part of this river, between Lake Pend Oreille and mouth of Priest River, has a channel from 500 to 1,000 feet wide, with a depth of from 25 to 50 feet at extreme low water. Five miles below the mouth of Priest River navigation is obstructed by Albany Falls, while below these falls the river is navigable at extreme low water, for boats drawing less than 6 feet, as far as the Blue Slide, a distance of 40 miles; and at a medium low stage (3 feet above extreme low water) it is navigable for such steamers as far as Box Canyon, a distance of about 60 miles, the obstructions in this part of the river consisting of sand and gravel bars and isolated rocks, but none are of a serious nature.

The most serious obstructions to navigation of the lower river are found in Box Canyon, where the river flows through a narrow gorge, 3,600 feet long, in which the river passes over large rocks which are effectual barriers to navigation at low water. Below the canyon, as far as Metalline, there is a fairly good channel at all seasons of the year, and the river is navigable for about a mile and a half below Metalline to Metalline Falls, which form the limit of navigation on the lower river.

Captain Taylor states that above Albany Falls the river needs no improvement; that to pass Albany Falls a lock would be required, the cost of which may be roughly estimated at $300,000, but that no detailed estimate has been attempted, as there is not the slightest reason for its construction; also, that between Albany Falls and Box Canyon there are a few isolated rocks which can be removed at incon-

siderable expense and to the great benefit of navigation, and that by the removal of certain submerged rocks and cutting off the worst of the projecting points Box Canyon can be improved sufficiently to enable boats to navigate it enough to bring out the products of the mines in the vicinity of Metalline.

An estimate is therefore submitted for the removal of 12,708 cubic yards of rock from the river, at a cost, including contingencies, of $30,000.

In his letter transmitting this report to this office Captain Taylor states:

In my opinion the proposed improvement of Box Canyon, as outlined in my report, is a worthy one and is justified by the interests of the commerce involved. The improvement of the river between Albany Falls and Box Canyon, to the limited extent of removing certain rocks, is also recommended, but aside from this work the interests of commerce involved do not justify the improvement of the river.

The views of Captain Taylor are concurred in by Colonel Suter, the division engineer.

The report was transmitted to Congress and printed in House Doc. No. 235, Fifty-fifth Congress, second session. (See also Appendix V V 20.)

EXAMINATIONS, SURVEYS, AND CONTINGENCIES OF RIVERS AND HARBORS.

For examinations, surveys, and contingencies of rivers and harbors an appropriation of $200,000 should be made, as follows:

For examinations, surveys, and contingencies, and for incidental repairs for rivers and harbors, for which there may be no special appropriation; for all expenses connected with the inspection of bridges reported as obstructions to navigation, with the service of notices required in such cases, with the location of harbor lines under the act of September 19, 1890; and for expenses connected with the examinations and reports by officers of the Corps of Engineers and by Boards of Engineers upon plans for bridges authorized by law to be built, and upon bridge bills, reports on which may be called for by Congress, $200,000.

SUPERVISION OF THE HARBOR OF NEW YORK.

The supervisors of the harbor during the year were Lieut. John F. Parker, U. S. N., to March 12, 1898; Lieut. Commander W. L. Field, U. S. N., from March 12, to April 1, 1898, and Lieut. Commander N. J. K. Patch, U. S. N., since April 1, 1898.

The office of supervisor of the harbor of New York was created by act of Congress approved June 29, 1888, entitled "An act to prevent obstructive and injurious deposits within the harbor and adjacent waters of New York City, by dumping or otherwise, and to punish and prevent such offenses." This act has been amended by section 3 of the act of August 18, 1894, entitled "An act making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes," by which amendment the functions and powers of the officer have been greatly enlarged. Additional duties are also conferred on the supervisor by section 2 of the last-named act.

The following additional legislation regarding dumping in the port of New York was introduced in the charter of Greater New York:

CERTAIN SUBSTANCES NOT TO BE DUMPED IN PORT OF NEW YORK.

SEC. 880. The placing, discharging, or depositing, by any process or in any manner, of refuse, dirt, ashes, cinders, mud, sand, dredgings, sludge acid, or any other refuse matter, *floatable or otherwise, in* the tidal waters of the port of New York as

defined by this act, except under permit of the United States supervisor of the harbor, is hereby strictly forbidden, and every person violating the foregoing provisions shall be guilty of a misdemeanor, and on conviction thereof shall be punished by a fine of not more than two hundred and fifty dollars nor less than five dollars, or imprisonment for not more than six months nor less than ten days, one-half of said fine to be paid to the person or persons giving information which shall lead to the conviction of such misdemeanor.

SCOWS TO RECEIVE ASHES, ETC., FROM STEAM TUGS AND VESSELS.

SEC. 881. The various scows employed by the city of New York, or by the contractors for removing ashes, garbage, and refuse of said city, while moored at the various dumping boards of said city, are hereby designated and required to receive directly any and all ashes or rubbish from any steam tug or steam vessel in the harbor, and in addition to the foregoing provisions two or more scows shall be located at such points within the harbor, as the supervisor of the harbor may direct, for the special use of boats and vessels wishing to discharge ashes or rubbish.

Under the provisions of section 5 of the act of June 29, 1888, a line officer of the Navy is designated to discharge the duties created by the act under the direction of the Secretary of War. On May 23, 1889, the Secretary of War directed that all communications in connection with these duties should be addressed to him through this office, and on February 1, 1890, he further directed that the powers conferred upon him by the act should be exercised through the Chief of Engineers.

The report of Lieutenant Commander Patch, describing for the fiscal year ending June 30, 1898, the operations in his charge, is submitted as Appendix W W.

The supervisor recommends that a new boat be built for the use of his office to take the place of the steam tug *Argus*, now unserviceable, and estimates the cost of a suitable boat for the purpose at $45,000.

He states in his report:

It will be readily seen * * " that a constant and vigilant patrol of the bay and harbor by the boats of this office is imperative to protect the channels from probable violations of the law involved in the movement of the enormous amount of refuse of all kinds, averaging yearly about 10,000,000 cubic yards.

In consideration of the large expenditure in the improvement of the harbor and channels of New York, it is economy to maintain an efficient patrol for their preservation.

Estimates for the fiscal year ending June 30, 1900.—The estimate of funds required for this service for the fiscal year ending June 30, 1900, is given in the above-mentioned report as follows:

For pay of inspectors, deputy inspectors, office force, and expenses of office..	$10,260
For pay of crews and maintenance of four steam tugs and three launches...	48,740
For new boiler and installing same in steam tug *Nimrod*	6,500
For purchase or construction of one steam tug.....	45,000
Total	110,500

MISSISSIPPI RIVER COMMISSION.

The Mississippi River Commission, constituted by act of Congress of June 28, 1879, is in charge of the improvement of the Mississippi River from the Head of Passes to the mouth of the Ohio River, including the rectification of Red and Atchafalaya rivers at their junction with the Mississippi; the building of levees, and the improvement of the several harbors for which specific appropriations have been made, with the exception of the harbor of Vicksburg and the mouth of Yazoo River. It is also charged with the survey of the Mississippi River from the Head of Passes to its head waters.

The Commissioners during the past fiscal year were: Brig. Gen. G. L. Gillespie, U. S. Volunteers, colonel, Corps of Engineers, president; Lieut. Col. Amos Stickney, Corps of Engineers; Maj. Thos. H. Handbury, Corps of Engineers; B. M. Harrod, Robert S. Taylor, Henry Flad, and Henry L. Marindin, assistant, United States Coast and Geodetic Survey.

The report of the Commission upon the operations under its charge during the fiscal year ending June 30, 1898, is submitted as Appendix X X.

The work of the Commission is carried on under "the direction of the Secretary of War in accordance with the plans, specifications, and recommendations of the Mississippi River Commission, as approved by the Chief of Engineers," and the work contemplated by law is the general improvement of the river, the building and repairing of levees, and surveys, the "improvement, surveys, building, and repair of levees to be made and carried on in such manner as in their opinion shall best improve navigation and promote the interests of commerce at all stages of the river."

The project of the Commission adopted in January, 1896, contemplates the building of levees, the annual dredging of channels through the shoal places and such minor bank work as may be necessary for the prevention of cut-offs, and the protection of harbors and threatened levee lines of exceptional importance.

The river and harbor act of June 3, 1896, provides for continued work for the improvement of the Mississippi River from the Head of Passes to the mouth of the Ohio during four years, commencing July 1, 1896, the total expenditure during this period, as allotted by years, not to exceed $9,000,000.

Estimate for the fiscal year ending June 30, 1900.—The following estimate of funds required for carrying on the works under the charge of the Commission for the year ending June 30, 1900, is submitted:

For improving Mississippi River from Head of Passes to the mouth of the Ohio River, including salaries and clerical, office, traveling, and miscellaneous expenses of the Mississippi River Commission	$2,583,333
For improving harbor at:	
Greenville, Miss	50,000
Delta Point, La	110,000
Natchez, Miss., and Vidalia, La	300,000
New Orleans, La	400,000
For improvement at head of Atchafalaya and mouth of Red River, La	25,000
Total	3,468,333

MISSOURI RIVER COMMISSION.

The Missouri River Commission, constituted by act of Congress of July 5, 1884, is in charge of the improvement and surveys of the Missouri River below Sioux City, Iowa.

The Commissioners during the past fiscal year were Lieut. Col. Amos Stickney, Corps of Engineers, president; Maj. Thos. H. Handbury, Corps of Engineers; Maj. W. H. Heuer, Corps of Engineers, to November 6, 1897; Maj. W. L. Marshall, Corps of Engineers, since November 6, 1897; Garland C. Broadhead; R. S. Berlin to July 6, 1897, and C. L. Chaffee since that date.

The river and harbor act of August 18, 1894, in making appropriations for improvement of Gasconade and Osage rivers, Missouri, provided that the funds should be expended by the Missouri River

Commission, and the work of improving these streams has since been carried on under its direction.

The report of the Commission upon operations under its charge during the fiscal year ending June 30, 1898, is submitted as Appendix Y Y.

The systematic plan under which the Commission is working, to such an extent as the appropriation acts permit, is that of the permanent improvement of the river in reaches, commencing at the lowest reach, as provided for by law. It is only by the application of appropriations to such systematic work that the improvement of the Missouri River can be accomplished. Allotments from the appropriations for work in detached localities can do but little good at such points, and all such allotments interfere materially with the progress of the systematic improvement, increase its cost, and postpone the time when commerce will commence to reap full benefit from the improvement.

Estimate for the fiscal year ending June 30, 1900.—The following estimate of funds required for carrying on the works under the charge of the Commission for the year ending June 30, 1900, is submitted, being, for the Missouri River, the amount authorized by the act of June 3, 1896:

Improving Missouri River from mouth to Sioux City, Iowa, including office and traveling expenses and salaries of Commission, surveys, gauges, physical data and publications, operating snag boat, and systematic improvement of first reach		$300,000
Improving Osage River, Missouri:		
For completion of lock and dam	$146,000	
General improvement, including surveys	25,000	
		171,000
Improving Gasconade River, Missouri:		
Snagging, etc		15,000
Total		486,000

CALIFORNIA DÉBRIS COMMISSION.

Act of Congress approved March 1, 1893, provided for the establishment of the California Débris Commission, to consist of three officers of the Corps of Engineers, appointed by the President, with the concurrence of the Senate, whose functions relate to hydraulic mining in the territory drained by the Sacramento and San Joaquin river systems in California. The Commission is empowered and required to adopt plans for improving the navigation of the rivers in the systems mentioned, to project and construct works for impounding detritus and preventing the deterioration of the rivers from the deposit of hydraulic mining and other débris, and to devise means and issue permits for resuming and carrying on hydraulic mining operations under conditions that will not injure other interests in the State. The powers of the Commission, methods of procedure, etc., are prescribed in the act in detail.

The Commissioners during the past fiscal year were Col. Chas. R. Suter, Corps of Engineers; Maj. Chas. E. L. B. Davis, Corps of Engineers, to November 19, 1897; Maj. W. H. Heuer, Corps of Engineers, since November 19, 1897, and Lieut. Herbert Deakyne, Corps of Engineers.

The report of the Commission upon operations during the fiscal year ending June 30, 1898, is submitted herewith as Appendix Z Z.

Estimate for the fiscal year ending June 30, 1900.—The Commission submits an estimate amounting to $15,000 for payment of the necessary expenses of the Commission during the fiscal year ending June 30, 1900.

BRIDGING NAVIGABLE WATERS OF THE UNITED STATES.

Plans and maps of locations of the following bridges, proposed to be erected under the authority of special acts of Congress, have been examined with a view to protection of the interests of navigation, and have been approved by the Secretary of War, as provided by the acts; and the local engineer officers have been furnished with copies of the instruments of approval and drawings showing plans and locations, and charged with the supervision of the construction of the bridges so far as necessary to see that they are built in accordance with the approved plans:

1. *Bridge of the city of Monroe, La., across Ouachita River at Desiard street.*—Plans for the construction of this bridge were approved by the Secretary of War July 2, 1897. (See Annual Report of the Chief of Engineers for 1897, p. 530.)

Plans for construction of timber crib work between the city bridge and the Vicksburg, Shreveport and Pacific Railway Bridge were submitted September 6, 1897; approved by the Secretary of War September 18, 1897.

2. *Bridge of the Columbia and Red Mountain Railway Company across Columbia River, at Northport, Wash.*—Plans and map of location for a bridge to be built under authority of act of Congress approved January 27, 1897, were submitted August 20, 1897; approved by the Secretary of War September 30, 1897.

3. *Bridge of Marietta and Williamstown Bridge Company across Ohio River between Marietta, Ohio, and Williamstown, W. Va.*—Plans and map of location were submitted November 2, 1897, and, pursuant to the requirements of the act of Congress of December 17, 1872, as amended by act of February 14, 1883, were considered by a Board of Engineers.

Modified plans, conforming to the requirements of the Board, were submitted January 26, 1898; approved by the Secretary of War February 4, 1898.

4. *Bridge of the Mifflin Bridge Company across Monongahela River at McKeesport, Pa.*—Plans and map of location for a bridge proposed to be built under authority of act of Congress approved February 25, 1897, were submitted January 22, 1898, and modified plans were received February 16, 1898; approved by the Secretary of War February 24, 1898.

5. *Bridge of the Louisville and Portland Bridge Company across the Louisville and Portland Canal.*—Plans for reconstruction of this portion of the bridge across the Ohio River at this locality were submitted January 5, 1898; approved by the Secretary of War March 2, 1898.

6. *Bridge of the Mississippi River, Hamburg and Western Railway Company across Bayou Bartholomew, Arkansas.*—Construction of this bridge was authorized by act of Congress approved March 12, 1898. Plans and map of location were received March 5, 1898; approved by the Secretary of War May 17, 1898.

7. *Bridge of Leflore County, Miss., across Yazoo River at Greenwood.*—Construction of this bridge was authorized by act of Congress of March 3, 1897, as amended by act approved April 29, 1898. Plans and map of location were submitted March 9, 1898; approved by the Secretary of War May 12, 1898.

8. *Bridge of the Bellaire-Benwood Bridge Company across Ohio River between Bellaire, Ohio, and Benwood, W. Va.*—Plans and map of loca-

tion were received February 16, 1897, and were referred to a Board of Officers of the Corps of Engineers, as required by section 4 of act of Congress of February 14, 1883.

In a report of April 23, 1897, the Board recommended that the company be required to provide a channel span 800 feet in length, with a height of 90 feet above low water, and modified plans conforming to these recommendations were submitted by the company April 22, 1898; approved by the Secretary of War May 26, 1898.

9. Bridge of Dale County, Ala., across Choctawhatchee River near Newton.—Plans and map of location for construction of this bridge under authority of act of Congress approved February 14, 1898, were submitted May 16, 1898; approved by the Secretary of War May 31, 1898.

10. Bridge of Dale County, Ala., across Choctawhatchee River near Old Hollis Bridge.—Construction of this bridge was authorized by act of Congress approved February 14, 1898. Plans and map of location were submitted April 28, 1898; approved by the Secretary of War May 31, 1898.

11. Bridge of the Chicago, Milwaukee and St. Paul Railway Company across Mississippi River between Prairie du Chien, Wis., and North McGregor, Iowa.—Plans and map of location for reconstruction and relocation of the existing bridge at this place, authorized by act of Congress approved March 30, 1898, were submitted June 11, 1898; approved by the Secretary of War June 29, 1898.

12. Bridge of the Yazoo and Mississippi Valley Railroad Company across Yalobusha River, in Leflore County, Miss.—Authority for construction of this bridge was granted by act of Congress approved July 7, 1898. Plans and map of location were submitted July 6, 1898; approved by the Secretary of War July 16, 1898.

13. Bridge of the Jonesboro, Lake City and Eastern Railroad Company across Lake St. Francis near Lake City, Ark.—Construction of this bridge was authorized by act of Congress approved June 16, 1898. Plans and map of location were received July 18, 1898; approved by the Secretary of War August 8, 1898.

14. Bridge of the Lewiston Connecting Bridge Company across Niagara River at Lewiston, N. Y.—The construction of this bridge was authorized by act of Congress approved May 22, 1896. Plans and map of location were submitted July 18, 1898; approved by the Secretary of War August 11, 1898.

15. Bridge of the Lewiston-Concord Bridge Company across Snake River between Lewiston, Idaho, and Concord, Wash.—Plans and map of location for a bridge to be built at this locality under authority of act of Congress approved February 15, 1898, were submitted November 26, 1897, and modified plans July 6, 1898; approved by the Secretary of War August 24, 1898.

Under the provisions of section 7 of river and harbor act approved September 19, 1890, amended by section 3 of river and harbor act approved July 13, 1892, bridges may be built over navigable waters entirely within the limits of any State, under the authority of legislative enactment of such State, when the plans and locations of the structures are approved by the Secretary of War. Plans and maps of locations of the following bridges proposed to be erected under these provisions have been examined, with a view to protection of the interests of navigation, and have been approved by the Secretary of War; and the local engineer officers have been furnished with copies of the drawings and instruments of approval, and charged with the supervision of con-

struction of the bridges so far as necessary to see that they are built in accordance with the approved plans:

1. *Bridge of the Erie Railroad Company across Passaic River at Newark, N. J.*—Plans for reconstruction of the approaches to this bridge were submitted September 2, 1897; approved by the Secretary of War September 16, 1897.

2. *Bridge of the city of Boston, Mass., across Fort Point Channel.*—Plans and map of location were submitted April 30, 1897; approved by the Secretary of War September 23, 1897.

3. *Bridge of Butler and Muhlenberg counties, Ky., across Mud River at or near Rochester, Ky.*—Plans and map of location were submitted February 27, 1897; approved by the Secretary of War October 2, 1897.

4. *Bridge of the United Railroads of Washington across Wishka River, Washington.*—Plans and map of location were submitted September 3, 1897; approved by the Secretary of War October 2, 1897.

5. *Bridge of the United Railroads of Washington across Hoquiam River, Washington.*—Plans and map of location were submitted September 3, 1897; approved by the Secretary of War October 2, 1897.

6. *Bridge of the city of Bridgeport, Conn., across Yellow Mill Pond at Stratford avenue.*—Plans for a bridge to replace the existing structure at this place were submitted September 3, 1897; approved by the Secretary of War October 4, 1897.

7. *Bridge of the city of Appleton, Wis., across the United States Fox River Canal at Lake street.*—Plans for reconstruction of the superstructure of the existing bridge at this place were submitted September 17, 1897; approved by the Secretary of War October 12, 1897.

8. *Bridge of Osage County, Mo., across Gasconade River at Rollins Ferry.*—Plans and map of location were submitted July 2, 1897, and modified plans were received September 17, 1897; approved by the Secretary of War October 19, 1897.

9. *Bridge of Craven County, N. C., across Trent River at Newbern.*—Plans and map of location were submitted October 4, 1897; approved by the Secretary of War October 26, 1897.

10. *Bridge of the city of Port Huron, Mich., across Black River at Elmwood street.*—Plans and map of location were submitted August 13, 1897, and modified plans October 8, 1897; approved by the Secretary of War October 26, 1897.

11. *Bridge of the city of New York across the channel between City Island and Pelham Bay Park.*—Plans for a bridge to replace the existing structure at this place were submitted October 12, 1897; approved by the Secretary of War October 29, 1897.

12. *Bridge of Cabell County, W. Va., across Guyandotte River at Salt Rock.*—Plans and map of location were submitted October 9, 1897; approved by the Secretary of War November 1, 1897.

13. *Bridge of the city of Chicago, Ill., across South Fork of South Branch of Chicago River at Archer avenue.*—Plans for a bridge to replace the existing structure at this place were submitted October 16, 1897; approved by the Secretary of War November 2, 1897.

14. *Bridge of the city of New York across Harlem River between One hundred and forty-fifth and One hundred and forty-ninth streets.*—Plans and map of location were submitted October 23, 1897; approved by the Secretary of War November 11, 1897.

15. *Bridge of the Chicago, Burlington and Quincy Railroad Company across Quincy Bay at Quincy, Ill.*—Plans for rebuilding the existing bridge at this place were submitted October 20, 1897; approved by the Secretary of War November 20, 1897.

16. Bridge of the Galveston, Brazos and Southwestern Railway Company across Chocolate Bayou, Texas.—Plans and map of location were submitted October 16, 1897; approved by the Secretary of War November 22, 1897.

17. Temporary bridge of the New York Central and Hudson River Railroad across Spuyten Duyvil Creek, New York.—Plans for a bridge to replace the existing structure at this place were approved by the Secretary of War August 28, 1894. (See Annual Report of the Chief of Engineers, 1894, page 430.)

Plans for a temporary bridge to be used during reconstruction of the permanent bridge were submitted November 6, 1897; approved by the Secretary of War November 22, 1897.

18. Bridge of the Detroit and Lima Northern Railway Company across Rouge River at Delray, Mich.—Plans and map of location were submitted October 23, 1897, and modified plans November 20, 1897; approved by the Secretary of War November 26, 1897.

19. Bridge of the Southeastern and Atlantic Railroad Company across Southern Branch of Elizabeth River at Norfolk, Va.—Plans for a bridge proposed to be built at this location by the New York, Philadelphia and Norfolk Railroad Company were approved by the Secretary of War February 8, 1897. (See Annual Report, Chief of Engineers, 1897, page 533.)

The location having been abandoned by the grantees, plans for a bridge at this place were submitted by the Southeastern and Atlantic Railroad Company November 12, 1897; approved by the Secretary of War November 26, 1897.

20. Bridges of the city of New York across Bronx River at Westchester avenue.—Plans and map of location of a permanent and a temporary bridge at this locality were submitted November 6, 1897; approved by the Secretary of War December 2, 1897.

21. Bridge of the town of Mukwa, Wis., across Wolf River at Northport, in said town.—Plans and map of location were submitted December 1, 1897; approved by the Secretary of War January 12, 1898.

22. Bridge of the Rapid Railroad Company across the northwest corner of Lake St. Clair, Michigan.—Plans and map of location of embankment, trestle, and drawbridge were submitted January 6, 1898; approved by the Secretary of War January 25, 1898.

23. Bridge of the Peoria and Pekin Traction Company across Illinois River at Pekin, Ill.—Plans and map of location were submitted January 20, 1898, and modified plans February 5, 1898; approved by the Secretary of War February 8, 1898.

24. Bridge of Whatcom County, Wash., across Nooksack River at Orvis Ferry.—Plans and map of location were submitted January 15, 1898; approved by the Secretary of War February 17, 1898.

25. Bridge of the city of Saginaw, Mich., across Saginaw River at Court street.—Plans and map of location were submitted February 7, 1898; approved by the Secretary of War March 2, 1898.

26. Bridge of Bergen County, N. J., across Hackensack River at Anderson street, Hackensack, N. J.—Plans for a bridge to replace the existing structure at this place were submitted February 22, 1898; approved by the Secretary of War March 14, 1898.

27. Bridge of the St. Paul, Minneapolis and Manitoba Railway Company across Steamboat River, Minnesota.—Plans and map of location were submitted February 28, 1898; approved by the Secretary of War March 14, 1898.

28. Bridge of the St. Paul, Minneapolis and Manitoba Railway Company across Kabekona Narrows, Minnesota.—Plans and map of location

were submitted February 28, 1898; approved by the Secretary of War March 14, 1898.

29. Bridge of Craven County, N. C., across Neuse River at Newbern.—Plans and map of location were submitted December 20, 1897, and modified plans March 11, 1898; approved by the Secretary of War March 22, 1898.

30. Bridges of the Boston and Providence Railroad Corporation, the Old Colony Railroad Company, and the New York, New Haven and Hartford Railroad Company across Fort Point Channel, Boston Harbor, Massachusetts.—Plans and map of location for two bridges were submitted February 23, 1898; approved by the Secretary of War March 24, 1898.

31. Bridge of Jefferson County, Tex., across Taylors Bayou.—Plans and map of location for a bridge at this place to replace one destroyed by storm were submitted March 3, 1898; approved by the Secretary of War March 28, 1898.

32. Bridge of the Kerckhoff-Cuzner Mill and Lumber Company across a slough of Wilmington Lagoon, inner harbor of San Pedro, Cal.—Plans were submitted December 27, 1897, and map of location March 25, 1898; approved by the Secretary of War March 29, 1898.

33. Bridge of the Queen Anne's Railroad Company across Lewes Creek at Lewes, Del.—Plans and map of location were submitted March 5, 1898; approved by the Secretary of War March 30, 1898.

34. Bridge of the Eastern Railway Company of Minnesota across Mississippi River in Minnesota.—Plans and map of location were submitted December 24, 1897; approved by the Secretary of War April 7, 1898.

35. Bridge of the Eastern Railway Company of Minnesota across Ball Club River, Minnesota.—Plans and map of location were submitted December 24, 1897; approved by the Secretary of War April 7, 1898.

36. Bridge of the New Kensington Bridge Company across Allegheny River at New Kensington, Pa.—Plans and map of location were submitted February 8, 1898, and modified plans April 2, 1898; approved by the Secretary of War April 8, 1898.

37. Bridge of the Monongahela Connecting Railroad Company across Monongahela River near Thirtieth street, South Side, Pittsburg, Pa.—Plans for construction of an additional span for a Y to the existing bridge at this place were submitted March 24, 1898; approved by the Secretary of War April 9, 1898.

38. Bridge of the Pittsburg and Lake Erie Railroad Company across Youghiogheny River between McKeesport and Reynoldton, Pa.—Plans for reconstruction of the existing bridge at this place were submitted April 8, 1898; approved by the Secretary of War April 29, 1898.

39. Bridge of Mr. Daniel Thompson across Bayou Teche at Calumet Plantation, La.—Plans and map of location were submitted March 3, 1898; approved by the Secretary of War May 5, 1898.

40. Bridge of the Lewiston, Brunswick and Bath Street Railway across New Meadows River between Brunswick and West Bath, Me.—Plans and map of location were submitted April 16, 1898; approved by the Secretary of War May 23, 1898.

41. Bridge of the town of Bourne, Mass., across Barlows River.—Plans for a bridge to replace the existing structure at this place were submitted April 25, 1898; approved by the Secretary of War May 24, 1898.

42. Bridge of the Allegheny and Western Railway Company across Allegheny River near Mosgrove, Pa.—Plans and map of location were submitted January 24, 1898, and modified plans February 11, 1898; approved by the Secretary of War February 23, 1898.

Plans providing for a modification of the approved plans so as to permit a reduction in length of spans and a change in construction of piers were submitted April 30, 1898; approved by the Secretary of War May 24, 1898.

43. Bridge of the Charleston and Seashore Railroad Company across a cove between Mount Pleasant and Sullivans Island, South Carolina.—Plans and map of location were submitted May 27, 1898; approved by the Secretary of War June 7, 1898.

44. Bridge of the Butters Lumber Company across Lumber River near Fairbluff, N. C.—Plans and map of location were received May 28, 1898; approved by the Secretary of War June 8, 1898.

45. Bridge of the Louisville and Nashville Railroad Company across Tennessee River at Danville, Tenn.—Plans for the reconstruction of the existing bridge at this place were submitted May 30, 1898; approved by the Secretary of War June 14, 1898.

46. Bridge of the Michigan Central Railroad Company across Little Calumet River near Chicago, Ill.—Plans for reconstruction of the existing bridge at this place were submitted May 21, 1898; approved by the Secretary of War June 16, 1898.

47. Bridge of the Louisville and Nashville Railroad Company across Cumberland River at Clarksville, Tenn.—Plans for construction of floating cribs between the center pier and rest piers of the drawspan of this bridge were submitted May 30, 1898; approved by the Secretary of War June 16, 1898.

48. Bridge of the county of Camden, N. J., across Cooper Creek at State street, Camden, N. J.—Plans for a bridge to replace the existing structure at this place were submitted May 23, 1898; approved by the Secretary of War June 16, 1898.

49. Bridge of the city of New York across Newtown Creek at Greenpoint avenue.—Plans for the reconstruction of the existing bridge at this place were submitted June 8, 1898; approved by the Secretary of War June 17, 1898.

50. Bridge of the Charleston and Seashore Railroad Company across Breach Inlet, between Sullivans Island and Long Island, South Carolina.—Plans and map of location were submitted June 25, 1898; approved by the Secretary of War July 6, 1898.

51. Bridge of the parish of St. Martin, La., across Bayou Teche at Breaux Bridge, St. Martinville, La.—Plans and map of location were submitted June 21, 1898; approved by the Secretary of War July 8, 1898.

52. Bridge of Walton County, Fla., across Black Creek.—Plans and map of location were submitted April 13, 1898; approved by the Secretary of War July 9, 1898.

53. Bridges of the Norwich and Worcester Railroad Company at entrance to Long Cove and Clarks Cove, Thames River, Connecticut.—Plans for the openings to be left at these localities in the embankments now being built along the Thames River, between Allyns Point and Groton, Conn., were submitted July 1, 1898; approved by the Secretary of War July 11, 1898.

54. Bridge of Haywood County, Tenn., across Big Hatchee River near Brownsville.—Plans and map of location were submitted June 20, 1898; approved by the Secretary of War July 16, 1898.

55. Bridge of the Atlantic Coast Line across Trent River near Polloksville, N. C.—Plans for reconstruction of the pivot pier of the draw of the bridge at this place were submitted July 19, 1898; approved by the Secretary of War August 2, 1898.

56. Bridge of Clatsop County, Oreg., across Youngs Bay at Astoria.—Plans and map of location were submitted March 12, 1898, and modified plans July 22, 1898; approved by the Secretary of War August 16, 1898.

57. Bridge of the Wilmington Railway Bridge Company across Cape Fear River at Navassa, N. C.—Plans for the reconstruction of the existing bridge at this place were submitted August 17, 1898; approved by the Secretary of War August 20, 1898.

58. Bridge of the Wilmington Railway Bridge Company across North East Branch of Cape Fear River, at Hilton, N. C.—Plans for the reconstruction of the existing bridge at this place were submitted August 17, 1898; approved by the Secretary of War August 20, 1898.

59. Bridge of the Pittsburg and Sharpsburg Bridge Company across Allegheny River from Pittsburg to Sharpsburg, Pa.—Plans and map of location were submitted August 16, 1898; approved by the Secretary of War August 24, 1898.

60. Bridge of the Mineral Range Railway Company across Portage Lake, between Houghton and Hancock, Mich.—Under date of March 1, 1898, the Secretary of War permitted the Mineral Range Railway Company to rebuild the drawbridge across Portage Lake, between Houghton and Hancock, Mich., on the same lines as at present and in accordance with its request as indicated in letter dated December 10, 1897.

Under the provisions of sections 4 and 5 of the river and harbor act approved September 19, 1890, relating to bridges obstructing navigation, plans for alteration of the following bridges, so as to render navigation through or under them reasonably free and unobstructed, have been examined and approved by the Secretary of War; and the local engineer officers have been furnished with copies of the plans and instruments of approval and charged with supervision of the work of alteration so far as necessary to see that the approved plans are complied with:

1. Bridge of the Central Pacific Railroad Company and the Southern Pacific Company across Sacramento River at Tehama, Cal.—Complaint having been made against the existing bridge as an obstruction to navigation, proceedings were instituted against it and notice of the Secretary of War, dated May 14, 1896, requiring the bridge to be so arranged as to provide the western drawspan with an opening of not less than 95 feet in the clear, measured at right angles to the current at low water, and for a depth of 4 feet below low water was served on the Southern Pacific Company May 27, 1896.

Plans for reconstruction of the bridge in accordance with requirements of the Secretary of War and for construction of false work necessary to prosecute the work were submitted January 28, 1898, conjointly by the companies owning and operating the bridge; approved by the Secretary of War February 23, 1898.

2. Bridge of the city of New York across Newtown Creek between Vernon and Manhattan avenues.—Plans for replacing the existing bridge at this place by a new structure to be built by the city of Brooklyn and county of Queens, N. Y., were approved by the Secretary of War November 21, 1896. (See Annual Report of the Chief of Engineers for 1897, p. 535.)

Plans to be in lieu of the existing approved plans were submitted May 25, 1898; approved by the Secretary of War June 3, 1898.

Notice dated June 30, 1898, was served on the mayor of New York July 5, 1898, requiring the alteration of this bridge to be made in accordance with approved plans.

3. Bridge of the county of Alameda across San Antonio Estuary (Oakland Creek) between Oakland and Alameda, Cal., at Webster street.—Complaint having been made against this bridge as an obstruction to navigation, proceedings were instituted against it and notice of the Secretary of War dated May 20, 1896, requiring the bridge to be provided with a draw of not less than 150 feet clear opening, the draw to be operated by other than hand power, was served on the board of supervisors of the county May 29, 1896. Plans for alteration of the bridge in accordance with these requirements were received April 15, 1898; approved by the Secretary of War August 11, 1898.

BRIDGES OBSTRUCTING NAVIGATION.

Under the requirements of sections 4 and 5 of the river and harbor act approved September 19, 1890, the Secretary of War notified the persons, corporations, or associations owning or controlling certain bridges obstructing navigation, after giving them a reasonable opportunity to be heard, to so alter said bridges as to render navigation through or under them reasonably free, easy, and unobstructed, specifying in the notice the alterations required to be made and prescribing a reasonable time in which to make them, as follows:

1. Bridge of the Far Rockaway Ferry and Improvement Company across Far Rockaway Bay, New York.—Notice dated September 17, 1897, served on the company September 23, 1897. Alterations required: To provide a draw opening 35 feet wide in the clear at the site of the present opening. Alterations to be completed October 15, 1897.

2. Bridge of the New York, New Haven and Hartford Railroad Company across Sakonnet River at Tiverton, R. I.—Notice dated April 28, 1898, served on the company May 7, 1898. Alterations required: Construction of a drawspan having an opening 100 feet wide in the clear and 25 feet deep at lowest low water, and two tidal ways each 100 feet wide and 1 foot deep at mean low water, or one such tidal way 200 feet wide and of the same depth. Alterations to be completed on or before May 1, 1899.

3. Bridge of the city of New York across Newtown Creek between Vernon and Manhattan avenues.—Notice dated June 30, 1898, served on the mayor of New York July 5, 1898. Alterations required: Widen the drawspans to a clear width of 98 feet; rebuild or strengthen the piers so that dredging can be done close to them without endangering the bridge; construct the draw so that it can revolve 360 degrees, and furnish the draw with steam or other efficient motor for turning it, together with rests parallel to the channel and large enough to protect the bridge when open. Alterations to be completed June 30, 1899.

OCCUPANCY OF AND INJURY TO PUBLIC WORKS BY CORPORATIONS AND INDIVIDUALS.

Under the requirements of section 2 of the river and harbor act approved July 5, 1884, and section 4 of the river and harbor act approved August 5, 1886, I have no report to submit of instances during the year in which piers, breakwaters, or other works built by the United States in aid of commerce or navigation were used, occupied, or injured by corporations or individuals.

MISCELLANEOUS.

[Public works not provided for in acts making appropriations for the construction, repair, and preservation of works on rivers and harbors.]

BRIDGES AT WASHINGTON, D. C.

REPAIR OF THE AQUEDUCT BRIDGE ACROSS POTOMAC RIVER.

This work was in the charge of Lieut. Col. Chas. J. Allen, Corps of Engineers.

In compliance with Senate resolution, January 21, 1893, an examination of the piers of this bridge was made with the aid of a diver. A report in detail of the examination was rendered June 21, 1893, and on the 17th of July following an estimate of the cost of repairs was submitted. By act of August 18, 1894, an appropriation of $51,070 was made for the repairs. Under this appropriation Piers Nos. 2, 3, 5, 6, 7, and 8 were repaired by means of Portland cement concrete in bags, placed by a diver, and the repair of Pier No. 4 was made by means of a cofferdam within which new masonry was laid in a large eroded cavity at the upstream end of the pier. This work was completed in August, 1895.

As the work of repairs proceeded it was found that the old masonry of the pier, which was built about 1838, had not been started from solid rock and that part of it was of poor quality. There was also a crack in the masonry extending nearly throughout the entire height of the pier. It was decided that it would be necessary before long to remove the defective masonry in the remainder of the pier and replace it by masonry of proper quality founded on the solid rock. The existing appropriation was insufficient for this purpose, and it was therefore necessary to ask a further appropriation. As the cofferdam would be needed for the proposed work, it was purchased from the contractors upon completion by them of their work in 1895.

The unexpended balance of the appropriation, amounting to $4,690.30, was covered into the Treasury.

A full report and estimate of the cost of removing all the old masonry of the pier from the coping down to the bottom and rebuilding from the bottom up was rendered under date of November 30, 1895, and printed as House Doc. No. 158, Fifty-fourth Congress, first session, and in the Annual Report of the Chief of Engineers for 1896, page 3886. The cost was estimated at $65,000, which sum was appropriated for reconstruction of Pier No. 4 by act of Congress of June 8, 1896.

A contract for the work of reconstruction of that pier was made with the Houston Construction Company, of Philadelphia, Pa., May 17, and approved May 28, 1897. The total estimated amount of the contract was $30,000.

By the terms of the contract the work was to be completed by November 1, 1897.

By the close of the fiscal year ending June 30, 1897, the contractors had most of their plant in position and had made some progress in quarrying rock for the work.

Work of the past fiscal year.—The false work, which during the work of reconstruction was to support the ends of the two spans resting on the pier, was repaired. The cofferdam was also repaired and pumped out. The trestle towers of the false work, which rest upon the crib work of the cofferdam, were blocked up by means of square piles driven to the rock and capped and secured to the crib, and by blocking

between the crib timbers. The ends of the bridge spans were then lifted from their bearings on the pier and remained suspended to the false work. These operations were in progress until about November 1, 1897. In the meantime the quarrying and cutting of stone for the face masonry of the pier had been in progress, but it proceeded slowly, and the contractors found difficulty in finding, in the quarry opened, a sufficient number of stones large enough for the lower courses of the pier. By November 1, 1897, less than one-half of the stones required had been cut and most of these were for the upper courses of the pier. In response to an application from the contractors for extension of time in which to complete their contract they were granted extension to June 30, 1898. In March they resumed work on the pier and by the latter part of April had removed a number of courses of the old masonry. On April 29 the officer in charge wrote to them that, on account of the existence of a state of war between the United States and Spain and the probability that the Aqueduct Bridge might need to be kept fully open for the maximum traffic of which it was capable, it was considered advisable to temporarily suspend the work of removal of Pier No. 4, under their contract, until the then crisis should be over, and that the bridge seats would have to be blocked up at the pier and the bridge made as stable as possible for the traffic to which it would be subjected for the next few months. They were requested to answer in writing and in the meantime to suspend the tearing down of the pier. The contractors, instead of answering this letter—which requested suspension of work on a single item—by a proposition that could be at least debated, as it was expected they would do, answered, in effect, under date of April 30, 1898, that they considered that the letter of the 29th of April and certain verbal orders claimed to have been given their engineer to suspend absolved them from performing any further work under the said contract and that they had withdrawn all of their employees from the care and maintenance of the cofferdam and false work of the bridge. The contract was annulled, by authority of the Department, May 27, 1898.

In May the ends of the bridge spans were substantially and securely blocked up with rubble masonry laid in Portland cement mortar and the granite bridge seats and the shoes replaced. After the masonry had substantially set the ends of the spans were lowered into position. This work of blocking up, etc., was done by hired labor.

July 1, 1897, balance unexpended	$63,553.57
June 30, 1898, amount expended during fiscal year	6,248.85
July 1, 1898, balance unexpended	57,304.72
July 1, 1898, outstanding liabilities	19.60
July 1, 1898, balance available	57,285.12

(See Appendix A A A 1.)

SURVEYS MADE IN COMPLIANCE WITH ACTS OF CONGRESS OF FEBRUARY 17, 1897, MARCH 3, 1897, AND JUNE 4, 1897.

Surveys for bridges at Washington, D. C., at the following localities, required by acts of Congress of February 17, 1897, March 3, 1897, and June 4, 1897, were made and reports thereon submitted:

1. *Survey and plan for a memorial bridge across Potomac River from the Naval Observatory Grounds, Washington, D. C., to the Arlington estate, Virginia.*—March 19, 1898, Lieut. Col. Chas. J. Allen, Corps of Engineers, submitted report of survey required by act of Congress of June 4, 1897.

It was found that the amount appropriated was inadequate to "secur-

ing designs and estimates" for the bridge in addition to the other work contemplated by the law; consequently the work has been limited to making survey, test borings, and soundings, and mapping the results of the survey, from which an estimate of the cost of a structure to be located as described in the act and of style to be decided upon can be made.

A preliminary estimate made by Colonel Allen shows that a bridge at the locality with masonry piers and steel superstructure, capable of ornamentation, having three fixed spans and one draw span with roadway of 40 feet width and two sidewalks each 10 feet in width, and with approaches affording the same width of travel way, can be built for about $1,385,000.

I concur in the opinion of Colonel Allen, however, that the character of bridge should not be definitely decided upon until after the subject has been given further study and calculations and estimates have been made, in order to admit of comparison as to economy, architectural merit, and utility. If all the work incident to the proper study and determination of the matter is done by the Engineer Department a further appropriation of $5,000 will be needed, but to invite competitive designs and estimates, to be submitted in accordance with general specifications prepared under the direction of the Engineer Department, which is the preferable course, the sum of $8,500 will be required to defray the necessary expenses, including prizes.

The report was transmitted to Congress and printed in House Doc. No. 388, Fifty-fifth Congress, second session. (See also Appendix A A A 2.)

2. Survey for construction of a bridge across the Eastern Branch of the Potomac River (Anacostia River), District of Columbia, in line with Massachusetts avenue extended eastward.—November 29, 1897, Lieutenant-Colonel Allen submitted report required by act of Congress of February 17, 1897.

For reasons set forth in his report Colonel Allen believes that the conditions of the locality and the requirements of the act will be most fully met by a steel-truss bridge resting on masonry piers, the bridge to be a deck bridge, except where it crosses the Baltimore and Potomac Railroad, where a through span will be required.

Plans are submitted for such a bridge, with fixed spans and having a total length, including approaches, of 2,517 feet, and width of 52 feet between railings, and the cost of its construction is estimated to be $441,208. The plans provide accommodations for ordinary highway traffic and for street-car tracks, as required by the law; also for the construction of a draw should one be required in the future.

The estimated cost of a bridge with a draw (swing span on a pivot pier) is $476,843, but the necessity for a draw is not now apparent.

The report was transmitted to Congress and printed in House Doc. No. 140, Fifty-fifth Congress, second session. (See also Appendix A A A 3.)

3. Plans and estimates of cost for a stone arch bridge, and also for a steel bridge with stone foundations, over Rock Creek on the line of Massachusetts avenue extended, Washington, D. C.—December 15, 1897, Col. D. D. Gaillard, United States Volunteers, captain, Corps of Engineers, submitted report required by act of Congress of March 3, 1897, which provides—

> That the Chief of Engineers of the Army shall report to Congress at its next regular session plans for and the cost of erecting a stone arch bridge, and also a steel bridge with stone foundations, over Rock Creek on the line of Massachusetts avenue extended, the full width of said avenue, and for this purpose the sum of two thousand dollars, or *so much thereof as may* be necessary, is hereby appropriated.

Colonel Gaillard submitted designs and estimates for both the stone arch bridge and steel bridge with stone foundations at the locality indicated.

The estimated cost of the stone arch bridge is $568,545 and for the steel bridge $199,204.

In transmitting this report I beg to state that in my judgment the interest of the public, the durability and permanence of the structure, as well as harmony with the apparent future conditions at the locality, will be best secured by the construction of the stone arch bridge at the site selected; then, too, the very material difference in the expense for maintenance and repairs leads me to think that in the end a stone bridge will be the more economical structure.

In this connection it may be proper to add that as the act mentioned above contemplates either a stone arch bridge or a steel bridge, the inquiries and investigations have, as a consequence, been limited to bridges of that character.

The report was transmitted to Congress and printed in House Doc. No. 163, Fifty-fifth Congress, second session. (See also Appendix A A A 4.)

MAINTENANCE AND REPAIR OF WASHINGTON AQUEDUCT, AND INCREASING THE WATER SUPPLY OF WASHINGTON, D. C.

These works were in the charge of Col. D. D. Gaillard, United States Volunteers, captain, Corps of Engineers, to May 3, 1898; of Lieut. Col. Edward Burr, United States Volunteers, captain, Corps of Engineers, from May 3 to May 30, 1898, and of Col. Theo. A. Bingham, United States Army, since that date.

1. Washington Aqueduct.—Gatehouses and other buildings were repaired. The former were repointed and covered with a wash of Portland cement; the latter were repainted or whitewashed. About 4.5 miles of picket and board fences was repaired and whitewashed.

During the past year, not including the occasions when the water level was lowered by the supply being shut off for the purpose of making repairs or of removing deposits from the conduit, the extreme fluctuation of water level in the distributing reservoir had a range of but 0.45 foot, as against 1 foot for the preceding year.

The borders of the Dalecarlia Reservoir have been cleared of underbrush and fallen trees; the more irregular banks have been graded, and the shallow, marshy portions partly filled and partly deepened.

All deposits were removed from the conduit, and the interior was carefully scraped and swept. The officer in charge reports that it is now an easy matter to keep the conduit clean by annual removals of the deposits.

An inspection of the entire interior of the conduit shows that none of the cracks plastered up in 1896 have reopened and that no new ones have developed.

The north connection of the by-conduit around the Dalecarlia Reservoir is in bad condition, rendering it unsafe to enter it to remove deposits, and permitting interchange of its waters with those of the reservoir.

Two thousand six hundred and sixty-five cubic yards of flint stone was crushed and spread upon the Conduit road during the year.

Extensive repairs were made to the dirt road, 2½ miles in length, between the Anglers' Club House and Great Falls.

Travel on the Conduit road has increased so greatly during the recent

years that it is impossible to keep up the present condition of the road out of the annual appropriation for operation, preservation, and repair of the Washington Aqueduct without detriment to other more vital parts of the aqueduct system. A separate annual appropriation for this purpose was recommended in the last Annual Report of the Chief of Engineers, and an appropriation of $1,000 was made by the act of June 30, 1898. An increase in this amount to $5,000 a year is recommended.

General repairs, such as cleaning out culverts and ditches, cutting down bushes, and trimming slopes, were made to the entire road between Georgetown and Great Falls.

The ordinary inspection of mains and repairs of leaks therein, oiling and working of valves and blow-offs, packing of valve pipes to prevent freezing, and investigations of applications for permission to tap mains were carried on during the year.

In response to a Senate resolution of January 10, 1898, Colonel Gaillard submitted a report upon the filtration of the water supply of the District of Columbia, which was printed as Senate Doc. No. 94, Fifty-fifth Congress, second session, and is appended hereto as part of Appendix B B B 1.

By act of March 3, 1897, an appropriation of $5,000 was made for constructing a new telephone line between the Washington Aqueduct office and Great Falls, Md. With this appropriation a new line was constructed during the year at an expense of $3,175.85, and has rendered excellent service. An effort was made to purchase long-distance telephones for the line, but was not successful, and hired instruments are used.

A complete report is made of all encroachments on aqueduct lands and all matters occurring during the year relating to these lands.

Measurements of the daily and hourly consumption and waste of water were made on June 22–23 and 28–29, 1898, and a mean of the two results gave the daily consumption as 47,288,733 gallons, an increase above that of the preceding year. Based upon an estimate of 264,302 consumers of Potomac water, this corresponds to a per capita daily consumption and waste of 170 gallons. Based upon a population of 280,782 in the District of Columbia, as determined by the police census taken in April, 1897, with an estimated increase in population of 3,000, irrespective of their source of water supply, it corresponds to a daily per capita of 168 gallons.

An extensive series of gaugings by current-meter observations in the conduit at two stations discloses the fact that at the lowest stage of the Potomac, with all deposits removed from the conduit and the distributing reservoir about 2 feet below its present level (146 feet above datum), the conduit is capable of discharging into that reservoir about 76,500,000 gallons per day.

This represents the ultimate capacity of the conduit, and the present daily consumption is about 62 per cent of this amount. Ten years ago it was but 35 per cent of the same amount. The necessity, therefore, for the construction of a new conduit between Great Falls and the distributing reservoir is only a question of time, and I strongly recommend that provision be made for this work in the near future.

The new conduit should be completed and ready for operation before the daily consumption equals the maximum capacity of the present conduit. To make the preliminary surveys and plans, acquire the necessary lands, and construct the conduit will involve operations extending over several years; therefore the inauguration of this work should be no longer deferred. The officer in charge states that estimates for

the preliminary operations will be submitted in the next Annual Report. The trunk mains leading to the city, however, are already overtaxed in supplying the present consumption of a little more than 47,000,000 gallons per day, and every increase in their volume of flow will be marked by a rapid decrease in pressures in those parts of the city supplied by gravity alone. It appears, therefore, that while the conduit is capable of supplying nearly 30,000,000 gallons per day in excess of the present rate of consumption, the trunk mains will receive but little benefit from the increased discharge of the conduit until some method is provided for bringing an additional supply of water from the distributing reservoir into the city.

In view of the state of war existing between the United States and Spain, and on account of the disastrous results which might ensue from an attempt by a hostile individual to cut off the water supply of the city by the destruction of the conduit, precautions have been taken by the officers in charge against such an occurrence.

Watchmen appointed by the War Department have been assigned to duty at the most advantageous points, and this force has been supplemented, as far as the limited means at the command of the officers in charge would allow, by the appointment as watchmen of several trusted employees of the aqueduct office, who have been assigned to a like duty.

Estimates are submitted for repairing the north connection of the by-conduit at the Dalecarlia Reservoir; for repairing the Conduit road; for building a combined storehouse and stable at Great Falls; for purchase or condemnation of a site for a storage yard; for protecting the inlet to the conduit at Great Falls, and for operation, maintenance, and repair of the Washington Aqueduct and its accessories.

Full explanation of these estimates, all of which have my approval, is given in the report of the officer in charge.

The estimates for the fiscal year ending June 30, 1900, are as follows:

For repairing the north connection of the by-conduit, Dalecarlia Reservoir	$3,000.00
For repairing the Conduit road	5,000.00
For building combined storehouse and stable at Great Falls	3,000.00
For purchase or condemnation of a site for a storage yard	10,000.00
For protection to the inlet to the conduit at Great Falls	5,000.00
For operation, maintenance, repair, etc., of the aqueduct and its accessories	21,000.00
Total	47,000.00

WASHINGTON AQUEDUCT.

Amount appropriated by act approved March 3, 1897	21,000.00
June 30, 1898, amount expended during fiscal year	20,129.59
July 1, 1898, balance unexpended	870.41
July 1, 1898, outstanding liabilities	866.03
July 1, 1898, balance available	4.38
Amount that can be profitably expended in fiscal year ending June 30, 1900	47,000.00

CONSTRUCTING TELEPHONE LINE.

Amount appropriated by act approved March 3, 1897	5,000.00
June 30, 1898, amount expended during fiscal year	3,175.85
July 1, 1898, balance unexpended, deposited with Treasurer of the United States	1,824.15

(See Appendix B B B 1.)

2. Increasing the water supply of Washington, D. C.—All operations on this project have been suspended, but will be resumed and actively prosecuted with the money appropriated by the act of June 30, 1898.

A watchman has been employed during the year at the new reservoir, whose duties include guarding the stone at the mouths of all the shafts except the one at Foundry Branch, which is under the care of the watchman at the distributing reservoir.

Raising the height of the dam at Great Falls.—By act approved March 2, 1895, $125,000 of the balance remaining from the appropriations for "increasing the water supply of Washington, D. C.," was made available for raising the height of the dam at Great Falls and other works rendered necessary by the raising of the dam and for damages on account of flooding of lands and other damages.

This work was successfully accomplished at a cost of $101,373, the balance ($23,627) of the amount appropriated reverting to the Treasury July 1, 1898. A recent inspection shows that since completion the dam has suffered no injury either from ice or freshets.

Washington Aqueduct Tunnel and Howard University Reservoir.—Upon recommendation of the Chief of Engineers, approved by the Secretary of War, an expert Commission was appointed to meet in Washington in December, 1895, to report upon the feasibility of completing the tunnel conduit. After a careful study of the subject and a thorough inspection of the tunnel conduit and the works connected therewith the Commission submitted its report (published in House Doc. No. 166, Fifty-fourth Congress, first session), which concluded with the statement—

> That it is our unanimous judgment that it is feasible to complete the tunnel conduit, with its appurtenances, ready for service, for the sum of $897,837, as stated in our estimate, and we believe that such completion will not be impracticable or too expensive, inasmuch as we know of no more economical method for bringing increased water supply from the reservoir in Georgetown to Washington, by pipes or otherwise.

The act approved June 30, 1898, making appropriations for the District of Columbia, appropriates the balance of $297,210.50 remaining in the Treasury from former appropriations for increasing the water supply of Washington, D. C., and an equal amount from the surplus general revenues of the District of Columbia for resuming work on the Washington Aqueduct Tunnel and the Howard University Reservoir and for prosecuting and completing the same; the work on the tunnel and accessories to be carried on in accordance with the plans of a Board of experts appointed by authority of the Secretary of War in November, 1895. The estimate of the Board for completing the tunnel was $897,837, and the estimate of Colonel Gaillard, for completing the Howard University Reservoir is $198,013.30. The completion of this reservoir is an essential part of this system.

The following estimates are submitted for the fiscal year ending June 30, 1900:

For completing the Washington Aqueduct Tunnel according to the estimate of the Board of experts	$303,410.00
For completing the Howard University Reservoir according to the estimate of Colonel Gaillard	198,013.30
	501,423.30

(See Appendix B B B 2.)

IMPROVEMENT AND CARE OF PUBLIC BUILDINGS AND GROUNDS, AND CARE AND MAINTENANCE OF THE WASHINGTON MONUMENT, IN THE DISTRICT OF COLUMBIA.

Officer in charge, Col. Theo. A. Bingham, United States Army.

The Executive Mansion has received the usual care and such repairs and improvements as the funds available would admit. Necessary painting has been done and new furniture, carpets, matting, curtains, etc., have been supplied from time to time as needed. An automatic exchange telephone system has been introduced, the hydraulic machinery for elevator replaced with an electric motor and apparatus, and the floor at east end of second story corridor leveled and thoroughly strengthened. Repairs of various kinds have been made to the greenhouses connected with the mansion and the old superstructure of west wing of conservatory replaced with a new superstructure with iron frame.

Every effort has been made to maintain the Washington Monument and its machinery in good condition. The boilers and machinery have been carefully examined and cleaned and the work of repainting the iron work in the interior of the shaft has been completed. The elevator receives the most careful attention, being constantly inspected by experts, and is believed to be as safe as it is in the power of man to make it. There were 138,874 visitors to the top of the shaft during the year, making a total of 1,548,696 persons who have made the ascent since the monument was opened to the public, October 9, 1888.

Inspections have been made from time to time of the various buildings occupied by the War Department, except the State, War, and Navy Department building, in connection with their care, repair, and safety.

At the propagating gardens and nursery repairs were made to the greenhouses and other buildings, about 500,000 plants propagated for use in the public parks, and a new greenhouse constructed.

The area of asphalt pavements in the parks has been extended by the construction of 425 square yards of asphalt roadway and 1,622 square yards of asphalt footwalk, and 860½ square yards of asphalt roadway and 1,014½ square yards of asphalt footwalks have been repaired and resurfaced.

Three of the small unimproved triangular reservations in northeastern section of the city have been partially improved, and twenty-one of the small unimproved reservations in same section have been marked with granite blocks set in the ground at their corners, to show that they are the property of the United States.

The bronze pedestal for the statue of Gen. John A. Logan and the polished granite base of the same have been erected in Iowa Circle.

Attention has been given to the telegraph line connecting the Capitol with the Departments and Government Printing Office, repairs having been made from time to time as needed. The desirability of replacing the present overhead system with underground conduits and cables is submitted for the action of Congress.

The damage done by a storm in February, 1897, to the iron pile wharf at Bridge Creek Landing, Virginia, near Wakefield, the birthplace of Washington, has not yet been repaired, there being no funds available for the work.

Attention is invited to the detailed report of the officer in charge and to his estimates and recommendations for the fiscal year ending June 30, 1900.

His estimates are as follows:

For the improvement and care of public buildings and grounds in charge of the Chief of Engineers		$114,106.00
For compensation of persons employed on public buildings and grounds.		57,220.00
For repair of existing telegraph lines connecting Capitol and Departments		1,500.00
For contingent and incidental expenses of public buildings and grounds.		500.00
For care of Washington Monument and maintenance of elevator:		
Salaries of employees	$8,520.00	
Fuel, lights, contingencies, etc	3,000.00	
		11,520.00
Total		184,846.00

Telegraph and telephone connections between the Executive Mansion, War Department, and other Departments, private wires.—Under an allotment of $7,000 made April 9, 1898, from the appropriation for "National defense (war)," act of March 9, 1898, telephone circuits have been constructed and completed between the Executive Mansion and the Executive Departments, with the exception of placing telephone instruments in the offices of the Secretary of the Treasury, Attorney-General, Secretary of the Interior, Postmaster-General, and the Secretary of Agriculture. These will be installed in July and the telegraphic connections will be completed, it is expected, during the same month by running the wires required to make a metallic circuit of the existing lines.

(See Appendix C C C.)

NORTHERN AND NORTHWESTERN LAKES—CORRECTING AND ISSUING CHARTS—SURVEYS—WATER LEVELS.

Local surveys on the Great Lakes by officers of the Corps of Engineers date from the early part of the present century, and the files of this office contain maps made by such officers as far back as the year 1817. From that time up to 1841 the surveys were made only in connection with improvements of various lake harbors and rivers tributary to the lakes, but by that time the needs of navigation had grown so as to demand something much more than the local and disconnected maps resulting from such surveys, and it was recognized that nothing less than a complete charting of the whole lakes and their connecting waterways would meet the requirements of the commerce to which they were destined. The "Survey of the Northern and Northwestern Lakes," as a systematic and connected work, was, therefore, inaugurated by the act of March 3, 1841, which appropriated $15,000 for that purpose. The work was duly assigned to the Corps of Engineers, and its continuation to completion in 1882 was provided for by forty additional appropriations of amounts varying from $10,000 to $175,000, aggregating, with the final appropriation of August 7, 1882, a grand total of $2,939,879. The field work was completed and the Lake Survey office, which had been located in Detroit, Mich., during the whole intervening period, except for a short time after the beginning of the work, when it was at Buffalo, N. Y., was closed in August, 1882, the records of the office being transferred to the Office of the Chief of Engineers, U. S. Army, in Washington, D. C., where they still remain. The final report of the survey was printed in November, 1882. The total cost of the entire work, including the engraving and printing of all charts, was $2,937,496.68, or $2,382.32 less than the total appropriated, and this surplus was thereupon returned to the United States Treasury. The survey involved a vast amount of astronomical, topographical, and hydrographical work, all of which was executed with the utmost skill and accuracy.

The work of printing, electrotyping, and issuing charts for the use of navigators and use in connection with lake harbor improvements or

other official purposes has been provided for since 1882 by appropriations aggregating $36,000, and during the same period a total of $12,059.50, derived from the sale of charts, has been turned into the United States Treasury, making the net cost of this service for the past sixteen years $23,940.50.

Up to February 20, 1890, charts were issued free to vessels navigating the lakes, one set to each registered vessel; additional charts furnished to such vessels, or those furnished to other private parties, being sold at the price of 30 cents each. From the above date the free issue, except for official purposes of the Government, was discontinued by Congressional action, and sales were made at a uniform rate of 30 cents each until July 6, 1890, since which time the price has been 20 cents each, except as follows: Duluth and Superior harbors (new), 30⅔ cents; Lake Superior, 1895 (new), 26⅔ cents; Chicago lake front, 1892, 25 cents; Buffalo Harbor and Niagara River, 6½ cents; Erie Harbor and Presque Isle, to May, 1898, 10 cents; since May, 1898, 24 cents.

During the last fiscal year corrections and additions were made in the Detroit office to 17 of the old charts, and work on new charts was as follows: *Chart No. 3, St. Marys River*, completed and photolithographed in colors, and now for sale at 20 cents per copy; *Chart No. 2, St. Marys River*, completed and in the hands of the lithographer; *Chart No. 1, St. Marys River* (completing the series), nearly ready for lithographing; new chart of *Lake Michigan*, in a single sheet, completed and in hands of lithographer. The substitution of colored lithographed charts for the finely engraved ones heretofore used is highly gratifying to vessel masters, as the distinction between safe and unsafe water areas is plainly apparent at a glance. It is therefore desirable that this method be extended to the other charts issued from this office as fast as we find it practicable to do so.

The field work of surveys included completing the remeasurement of the Mackinac base line, with which the triangulation for the new charts of St. Marys River is connected, and observations for magnetic variation and dip at twenty stations distributed over the St. Marys River, Straits of Mackinac, north end of Lake Michigan, easterly approaches to Green Bay, Traverse Bay sections on the east shore of Lake Michigan, and the Beaver Island Group.

The number of charts sold or issued from the United States Engineer Office at Detroit, Mich., during the past year was 4,411. In addition a number were sold from this office. The total proceeds from sale of charts were $686.58, which was turned into the United States Treasury.

Because of the wonderful increase of commerce on the lakes and greatly increased draft of vessels now engaged in it as a result of recent improvements of harbors and waterways, it has become highly important that areas which have been sufficiently surveyed and charted for the old condition of a 12-foot navigation be resurveyed and recharted. A great deal has already been done in this direction under appropriations made since 1889 "for surveys, additions to and correcting engraved plates," the aggregate of ten successive appropriations for that purpose up to the date of this report being $180,000. This has enabled many localities to be reexamined, and has been specially important as providing the means for a resurvey of the greater part of the St. Marys River; but very much more remains to be done to perfect the general system of charts to meet the needs of the present conditions of navigation, and it is of the highest importance that it be done as soon as possible.

The specific object of all work thus far done under appropriations for the "Survey of the Northern and Northwestern Lakes" has been *the production* of a complete and accurate series of charts of these

lakes, and this object has been fully realized; so that we have now mapped the hydrography, and in many parts the shore topography, to a degree of perfection that is not excelled by any other set of charts in existence. To maintain them so—by local surveys for developing natural or artificial changes, making corresponding corrections or additions to the charts, and reproducing them in colors for the use of the mariner—will require an expenditure of not less than $50,000 annually, and this amount must be considered insignificant when compared with the immense commercial interests at stake. But the matter of supreme importance now in relation to these Great Lakes is an exhaustive investigation of the influences which affect the levels of their water surface in order to determine the extent to which they may be regulated and in what way the depth of their navigable channels may best be preserved. The Sundry Civil Act of June 4, 1897, in appropriating for completing the 20-foot ship channel between Chicago, Duluth, and Buffalo, directs that such "observations and investigations" be made, and after careful consideration a project of operation was submitted, of which the following is an extract:

For a complete study concerning the preservation of the depth of this channel and those tributary to it, we need a comprehensive knowledge of the natural phenomena which tend to cause changes in their beds and in the elevation of the water surface. This means, in short, that we must have an accurate understanding of the physics of the lake basins. There is undoubtedly a vast amount of trustworthy information on this subject; but all efforts thus far made to group and analyze it have shown such inconsistencies and lack of essential data that safe conclusions can be deduced from it only in exceptional and limited cases. What is essentially needed is that this information be now supplemented by a systematic, connected, and continuous series of observations. When that is done we may confidently anticipate that an intelligent reduction of the whole will supply sound principles and rules for the conservation and extension of our lake improvements.

The project here submitted is designed to inaugurate this series of observations. It is intended, however, only to outline the general features of the work, leaving details to be developed with the progress of operations except as respects those which should be entered upon at once. As a result of the whole work it is desired to determine with all possible precision the following factors in the problem of improvements:

1. The laws of flow from one lake to the other at varying stages of water.
2. The causes and extent of fluctuations of lake levels from year to year.
3. The effect of Government improvements already made or that may be made on lake levels.
4. The effect of the Chicago drainage canal, or other like artificial outlet, on lake levels.
5. The practicability and advisability of regulating lake levels by dams or locks and dams.
6. The nature and effect of currents, with special reference to the transportation of loose material and its obstruction of channels.
7. The effect of gales, storm waves, and barometric pressure on lake levels and currents.
8. Ice effects, as respects action on channels and interference with navigation.

The work required in the series of observations may be summarized as follows: (*a*) Measurements of discharge through and surface slopes of lake-connecting channels; (*b*) soundings and borings in rivers and lakes; (*c*) lake current observations and measurements; (*d*) continuous records of water gauges, force and direction of winds, and other meteorological data at selected stations.

It was determined, after mature deliberation, that the work above outlined should not all be done at the expense of the ship channel appropriation, but that appropriations for "Surveys of the Northern and Northwestern Lakes" and for the Deep Waterways Commission were more directly applicable to some of its most important features. Preparations for its inauguration were commenced about June 1, 1898, but active operations had not been entered upon up to the close of the fiscal year. The project thus commenced looks to progressive and continuous work extending through a period of several years. During the same

time all existing data that may have bearing on the general problem should be systematically compiled and carefully considered in connection with the information developed by this work. The results, it is confidently believed, will reach far beyond the special questions with which the investigations are immediately connected, and supply a vast fund of reliable information concerning the hydraulics of large rivers, and other questions of the greatest practical and scientific interest.

The total cost of making and reducing the observations can not be estimated with precision, but it is quite safe to say that the completion of the work in a satisfactory and conclusive shape is likely to call for an expenditure of at least $300,000, of which $250,000 may be assumed as attaching to work from the head of the upper lakes to the Niagara River, inclusive, and $50,000 to Lake Ontario and the St. Lawrence River.

The character of these investigations is such as to ally them most intimately with work heretofore done under appropriations for the "Survey of the Northern and Northwestern Lakes," and for that reason it is recommended that provision for their future prosecution be made wholly in that appropriation. The amount needed for reasonable progress during the year 1900 is $100,000, after which appropriations aggregating $200,000 in the three following years would probably suffice to complete the work. The estimate submitted for the year 1900 for this work and that connected with the correction of existing charts and the preparation of new ones is, therefore, as follows:

Estimate for the fiscal year ending June 30, 1900.

For Survey of the Northern and Northwestern Lakes, including all expenses connected with correcting, extending, and issuing charts, and observations and investigations of lake levels, to be available until expended	$150,000.00
July 1, 1897, balance unexpended	$36,703.94
June 30, 1898, amount expended during fiscal year	15,552.78
June 30, 1898, balance unexpended	21,151.16
Amount appropriated by Sundry Civil Act approved July 1, 1898	28,000.00
July 1, 1898, balance unexpended	49,047.56

Dates and amounts of appropriations for Survey of Northern and Northwestern Lakes.

March 3, 1841	$15,000	March 2, 1868	$77,500
May 18, 1842	20,000	July 20, 1868	75,000
March 1, 1843	30,000	March 3, 1869	100,000
June 17, 1844	20,000	July 15, 1870	100,000
March 3, 1845	20,000	March 3, 1871	175,000
August 8, 1846	25,000	June 10, 1872	175,000
August 12, 1848	25,000	March 3, 1873	175,000
March 3, 1849	10,000	June 23, 1874	175,000
September 28, 1850	25,000	March 3, 1875	150,000
March 3, 1851	25,000	July 31, 1876 (not including $16,000 applied to survey of Mississippi River)	84,000
August 30, 1852	25,000	March 3, 1877 (not including $25,000 applied to survey of Mississippi River and including $9,500 received from sale of steamers)	94,500
March 3, 1853	50,000	June 20, 1878 (not including $49,500 applied to survey of Mississippi River)	49,500
August 5, 1854	50,000	March 3, 1879	85,000
March 3, 1855	50,000	June 16, 1880	40,000
August 30, 1856	50,000	March 3, 1881	18,000
March 3, 1857	50,000	August 7, 1882	12,000
June 12, 1858	75,000		
March 3, 1859	75,000		
June 21, 1860	75,000		
March 2, 1861	75,000		
July 5, 1862	105,000		
February 9, 1863	106,879		
July 2, 1864	100,000		
February 28, 1865	125,000		
June 12, 1866	50,000		
March 2, 1867	77,500	Total	2,939,879

PRINTING AND ISSUE OF CHARTS FOR USE OF NAVIGATORS, AND ELECTROTYPING COPPERPLATES FOR CHART PRINTING.

March 3, 1883	$3,000	August 5, 1892	$2,000
July 7, 1884	3,000	March 3, 1893	2,000
March 3, 1885	3,000	August 18, 1894	2,000
August 4, 1886	2,000	March 2, 1895	2,000
March 3, 1887	2,000	June 11, 1896	2,000
October 2, 1888	2,000	June 4, 1897	2,000
March 2, 1889	2,000	July 1, 1898	3,000
August 30, 1890	2,000		
March 3, 1891	2,000	Total	36,000

SURVEYS AND ADDITIONS TO AND CORRECTING ENGRAVED PLATES.

March 2, 1889	$5,000	March 2, 1895	$25,000
August 30, 1890	10,000	June 11, 1896	25,000
March 3, 1891	10,000	June 4, 1897	25,000
August 5, 1892	5,000	July 1, 1898	25,000
March 3, 1893	25,000		
August 18, 1894	25,000	Total	180,000

(See Appendix D D D 1.)

Preservation of bench marks along the Erie Canal.—The project is to temporarily transfer and secure these bench marks until the completion of the work on the canal by the State of New York, when they will be transferred back to the walls of the locks and piers of the bridges. The sum of $471.54 was expended during the fiscal year on account of the appropriation for "Survey of Northern and Northwestern Lakes." The work was in the charge of Maj. William S. Stanton, Corps of Engineers; and his report will be found in Appendix D D D 2.

Annual water levels of the Northern and Northwestern Lakes.—A table showing the monthly means of water levels from July 1, 1897, to June 30, 1898, at Charlotte and Oswego, Lake Ontario; at Erie, Conneaut, Ashtabula, Cleveland, and Monroe, Lake Erie; at Milwaukee, Lake Michigan; at Escanaba, on Green Bay (no observations being made at this latter place from December 1, 1897, to April 14, 1898, inclusive); at Sand Beach, Lake Huron, and Sault Ste. Marie and Marquette, Lake Superior, being a continuation of that published in the Annual Report of the Chief of Engineers for 1897, will be found in Appendix D D D 3.

Charts.—Under the supervision of this office during the fiscal year additions have been made to the engraved plates of—

Lake Superior, No. 1.
Lake Superior, No. 3.
Portage Lake and River.
L'Anse and Keweenaw Bay, Lake Superior.
River Ste. Marie, No. 1.
River Ste. Marie, No. 2.
Straits of Mackinac.
North end of Lake Michigan.
Beaver Island Group, Lake Michigan.
North end of Green Bay.
South end of Green Bay.
Grand and Little Traverse bays, Lake Michigan.
Lake Huron.
St. Clair River.
Lake St. Clair.
Detroit River.
Lake Erie.
Coast chart No. 1, Lake Erie.
Coast chart No. 6, Lake Erie.
Coast chart No. 7, Lake Erie.
Lake Ontario.
Coast chart No. 1, Lake Ontario.
St. Lawrence River, No. 3.
St. Lawrence River, No. 5.
St. Lawrence River, No. 6.

An edition of each of the following charts has been printed:

Chart No. 3, St. Marys River.
Erie Harbor and Presque Isle, Pennsylvania.

A new chart of Lake Michigan and Chart No. 2, St. Marys River, have been completed and will be photolithographed and printed at an early date.

RECONNAISSANCES AND EXPLORATIONS.

The following officers have been on duty at the headquarters of the military departments, engaged in preparing such maps and making such surveys as were required by their respective commanding officers:

Maj. John D. Miley, United States Volunteers, First Lieutenant, Second Artillery, at Department of California.

Lieut. John B. Bennet, Seventh United States Infantry, at Department of the Columbia.

Maj. John D. Miley, United States Volunteers, First Lieutenant, Second Artillery, Acting Engineer Officer, Department of California, reports that sheets 32, 33, 44, 46, 110, and 127 of the Progressive Military Map of the United States were finished and forwarded to the Adjutant-General of the Army March 23, 1898, after which all work on that map was ordered abandoned; that numerous maps of the Island of Cuba and of the Philippine Islands were mounted; that firing charts for the newly mounted high-power guns for the defense of San Francisco Bay were carefully prepared, having arcs, graduated in azimuth, from each end of the base line, and also from the position of the gun. The supply of instruments was considerably drawn upon to partially outfit the Engineer Department of General Merritt's expedition.

(See Appendix E E E 1.)

Lieut. John B. Bennet, Seventh United States Infantry, Acting Engineer Officer, Department of the Columbia, from January 12, 1898, reports that the only field work done was several short surveys and lines of levels for the extension of the sewerage system at Vancouver Barracks; that office work consisted of preparation of maps, tracings, and solar prints of the sheets of the Military Progressive Map of the United States; of making tracings of Fort Spokane Military Reservation; of town of Sitka, Alaska; of United States Reservation at Fort Wrangel; of the Dalton, Chilcot, and Skagway trails, and maps of the State of Washington; of Northwest Territory from Dyea Inlet to Dawson City; of the Middle Yukon, Copper, and Tanana rivers, with coast from Cape Manby to Cooks Inlet; large drawing of Nanson's arctic stove. Maps of the Department have been issued; maps and plans drawn by hand; tracings and solar prints made; maps mounted, and other miscellaneous work done. The Alaska exploring expeditions from the Department of the Columbia were equipped by the Engineer Office with necessary maps, surveying instruments, photographic apparatus, and material.

(See Appendix E E E 2.)

ESTIMATES FOR AMOUNTS REQUIRED FOR SURVEYS AND RECONNAISSANCES IN MILITARY DEPARTMENTS, AND FOR MAPS, INCLUSIVE OF WAR MAPS.

For military surveys and reconnaissances and surveys of military reservations by the engineer officers attached to the several headquarters of military departments, being an average of $2,142.86 for each of seven military departments west of the Mississippi River, $15,000; for publication of maps for use of the War Department, inclusive of war maps, $10,000; total, $25,000.

Attention is specially invited to this estimate for appropriation and to the important uses for which it is intended.

At the headquarters of the military departments west of the Mississippi River there are stationed officers of the Corps of Engineers, or

other officers detailed to act, whose duty it is to make reconnaissances for military purposes, to make such surveys and prepare such maps as may be required by their respective commanding officers. In recent years no appropriations have been made for these purposes, and, consequently, these officers have been very much cramped for lack of the necessary means, and the usefulness of their offices has been very much reduced in consequence. The maps of these departments are constantly in need of revision and additions, which the officers make so far as possible; but with no means, even for the purchase of paper, their efforts are limited in results.

Paragraph 351 of the Army Regulations requires that the commanding officer of each post where there are fixed batteries bearing upon a channel will call upon the Engineer Department for accurate charts showing the soundings to the extent of the ranges of the guns. Calls upon this department to perform its duty under this regulation can not be honored from lack of means.

Interest in the war maps published by this office and republished by virtue of the Sundry Civil Act of March 2, 1889, continues very active. Of the 1,100 copies of each map printed under the act alluded to, all those not printed in this office (47 sheets) have been exhausted for some time, and the calls for them can only be honored with sets deficient in that number of sheets.

Besides all this, there is much information in this office relative to military geography which could with little expense be made available for the information of officers of the Army; for instance, there are on the office files detailed maps of regions of Europe which may become at an early day the theaters of war, and it would be of great advantage to the service if such information as these maps give could be made available for the study of officers, especially on the outbreak of hostilities. Were the means provided, this office would be glad to compile and to disseminate the information on its files.

It is the policy of this country to keep a standing army small in numbers, but it is its expectation that it should be a highly-instructed one, and a small outlay, as here referred to, will be conducive to that end.

Applications from officers of the Army have been received for maps of certain regions of Europe, and it was with great regret that this office could not render this assistance to officers desirous of improving themselves professionally, especially when the material was on its files.

OFFICE OF THE CHIEF OF ENGINEERS.

During the fiscal year ending June 30, 1898, the following-named officers were on duty in this office as assistants:

Lieut. Col. Alexander Mackenzie.

Capt. George W. Goethals, Lieutenant-Colonel, United States Volunteers, until May 26, 1898.

Capt. Joseph E. Kuhn, Major, United States Volunteers.

Lieut. Edgar Jadwin, Major, United States Volunteers, from October 14, 1897, to June 29, 1898.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

APPENDIXES

TO THE

REPORT OF THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

APPENDIXES

TO THE

REPORT OF THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

FORTIFICATIONS, ETC.

APPENDIX No. 1.

REPORT OF THE BOARD OF ENGINEERS.

THE BOARD OF ENGINEERS, ARMY BUILDING,
New York City, July 1, 1898.

GENERAL: I have the honor to submit the annual report recounting the operations of The Board of Engineers for the year ending June 30, 1898.

The following change in the personnel of the Board has taken place since the date of the last annual report:

By letter from Headquarters, Corps of Engineers, dated April 4, 1898, Maj. John G. D. Knight, Corps of Engineers, was, at his own request, temporarily relieved from duty as a member of the Board, "owing to his important and absorbing duties in connection with the Battalion of Engineers and the purchase of material for torpedo defense."

As at present constituted The Board of Engineers consists of the following-named officers of the Corps of Engineers: Col. Henry M. Robert, president; Col. G. L. Gillespie, Brigadier-General, United States Volunteers; Maj. Henry M. Adams, and Capt. H. F. Hodges, Lieutenant-Colonel, United States Volunteers.

In addition, the division engineers are members of the Board when matters pertaining to defensive works in their respective divisions are under consideration.

The Board has considered the various subjects referred to it during the past year by the Chief of Engineers, and the following is a brief summary of the reports rendered thereon:

1897.
July 8. On the artillery defense of Cumberland Sound, Georgia and Florida.
July 8. On the submarine-mine defense of Cumberland Sound, Georgia and Florida.
July 8. Special report in connection with the defense of Cumberland Sound.
July 13. On letter from Maj. D. W. Lockwood, Corps of Engineers, relative to the location of gun batteries recommended by The Board of Engineers for the defense of Narragansett Bay, in connection with the condemnation of land on Conanicut Island.
July 21. On the submarine-mine defense of Narragansett Bay.
Aug. 17. On the completion and testing of 6-inch rapid-fire gun, and disappearing carriage therefor, proposed by Ordnance Department.
Aug. 17. On the supply of rapid-fire guns.

1897.

Aug. 17. On modifications in ammunition lift for 10-inch B. L. R. emplacements.

Aug. 17. On 3-inch (16-pdr.) rapid-fire guns for defense of mine fields.

Aug. 24. On letter from Barber Asphalt Paving Company, July 2, 1897, relative to the use of asphaltic concrete in fortifications.

Aug. 24. On offer of Mr. T. F. Lane, to the Board of Ordnance and Fortification, to furnish a 37-mm. Maxim automatic machine gun and mount therefor, for trial.

Aug. 24. On letter from commanding officer U. S. S. *Oregon*, referred from Navy Department to Secretary of War under date of July 15, 1897, calling attention to the defenseless condition of Puget Sound and the advisability of strongly fortifying Port Angeles, Wash.

Sept. 14. On the submarine-mine defense of Pensacola, Fla.

Sept. 17. On plans for dredge for Pensacola Harbor, submitted by Maj. F. A. Mahan, Corps of Engineers.

Sept. 20. On plans, specifications, and estimate for target to test experimental parapet of the present adopted typical section, and one of the section proposed by the Honorable Secretary of War.

Sept. 29. On the submarine-mine defense of Portland, Me.

Oct. 9. On amended design for platform for 12-inch mortar carriage, model 1896.

Oct. 19. On indorsement of the Chief of Engineers of October 14, 1897, in regard to the award of contract for furnishing oil engines, the specifications for which were invited by Maj. John G. D. Knight, Corps of Engineers.

Nov. 3. On indorsement of the Engineer Department of July 29, 1897, referring for report a letter from the Department of the Interior, of July 20, 1897, asking if Wasp and Reef islands, in the Strait of Juan de Fuca, are needed for military purposes.

Nov. 3. On indorsement of the Engineer Department, of August 4, 1897, referring for report letter from the Department of the Interior, of August 10, 1897, stating that an application is pending from Charles A. Phelps for the survey of a certain island in the strait of Juan de Fuca, and asking if such island is likely to be needed in the future by the War Department.

Nov. 3. On indorsement of the Engineer Department, of October 14, 1897, referring for remark a letter from First Lieut. J. T. Honeycutt, First Artillery, of September 10, 1897, forwarding a printed paper entitled "Reply to the Report of the Board on Seacoast Mortar Fire."

Nov. 16. On distribution of rapid-fire guns and old armament for the defense of Charleston, S. C.

Nov. 16. On distribution of rapid-fire guns and old armament for the defense of Wilmington, N. C. (Cape Fear River).

Nov. 24. Relative to the preparation of a new plan for ammunition delivery in batteries mounting 12-inch guns (chain lift).

Dec. 1. On distribution of old armament at Fort Monroe, Va.

Dec. 1. On oil engines for use in mine field operations.

Dec. 1. On inspection report of Col. C. R. Suter, Corps of Engineers, Division Engineer of the Pacific Division, relative to fortifications at San Diego, Cal.

Dec. 1. On rapid-fire armament for defense of San Diego, Cal.

Dec. 3. On changes in azimuth circles for 12-inch mortar carriages.

Dec. 3. On the subject of the substitution of disappearing mounts for lift emplacements, and the advisability of undertaking the construction of armored casemates in the immediate future.

Dec. 8. } Dec. 20. } On rammers and staves for B. L. rifles on disappearing carriages.

Dec. 8. On revised emplacement for 10-inch B. L. R.

Dec. 16. On Raftery boom gates for coast defense.

Dec. 16. On mounts for 12-inch guns for Portland, Me., Boston, Mass., Potomac River (Washington, D. C.), Charleston, S. C., Pensacola, Fla., Delaware River (Philadelphia), and Baltimore, Md.

Dec. 20. On location of passageway in magazines in revised emplacement for 10-inch B. L. R.

Dec. 24. On purchase of property at Fort Wadsworth belonging to the King estate.

Dec. 27. On mounts for 12-inch guns for Mobile, Ala., Key West, Fla., San Francisco, Cal., and mouth of Columbia River.

Dec. 29. On sites for rapid-fire guns at Charleston, S. C.

Dec. 29. On mounts for 12-inch guns and rapid-fire armament for Savannah, Ga.

Dec. 31. On Ordnance Department alterations in platform plate for 10-inch disappearing carriage, L. F., model 1896.

Dec. 31. On reconsideration of project for defense of Narragansett Bay in connection with petition of property owners and residents of Conanicut Island.

Dec. 31. Letter on the subject of a continuous representation of the Corps of Engineers on the Board of Ordnance and Fortification.

1898.

Jan. 11. On petition for defense of Humboldt Harbor, California.
Jan. 11. On inspection report of Col. C. R. Suter, Corps of Engineers, relative to fortifications at mouth of Columbia River.
Jan. 12. On distribution of rapid-fire guns and old armament for Mobile, Ala.
Jan. 27. On retention of reservation at Proctorsville, La., for military purposes.
Jan. 27. On letter of Maj. F. A. Mahan, Corps of Engineers, relative to providing lights in mortar pits of the new mortar battery or in the emplacement for 10-inch battery near Fort Pickens.
Jan. 29. On system of James Acton Miller for use of iron in fortifications.
Feb. 5. On revised design for ammunition hoist for 10-inch B. L. R.
Feb. 5. } Feb. 12. } On revised emplacement for 12-inch B. L. R.
Feb. 23. On transfer of torpedo system to the artillery branch of the service.
Feb. 23. On submarine mine defense of Charleston, S. C.
Mar. 1. On the probable effect upon the surrounding buildings of practice firing from the mortar battery at Grovers Cliff, Boston Harbor.
Mar. 1. On the placing permanently at Fort Monroe a new 8-inch rifle on all-round barbette carriage.
Mar. 1. On positions for rapid-fire guns for resisting naval attack and for sweeping mine fields at entrance to Pensacola Bay, Florida.
Mar. 1. On effect of gun practice at Portland Head, Maine, on the neighboring light-house.
Mar. 1. On submarine mine defense of New Orleans, La.
Mar. 8. On sites for rapid-fire guns for Savannah Harbor.
Mar. 8. } Mar. 16. } Preliminary report on artillery and submarine mine defense of Port Royal Sound, South Carolina.
Mar. 8. Preliminary report on artillery and submarine mine defense of mouth of St. Johns River.
Mar. 14. Letter preliminary to report called for from Board on the subject of dampness in magazines.
Mar. 14. On offer of the Pneumatic Torpedo and Construction Company for construction of batteries.
Mar. 14. On mounts for 12-inch guns for New York Harbor.
Mar. 15. On small caliber rapid-fire guns for defense of New York Harbor.
Mar. 16. On distribution of rapid-fire guns for Wilmington, N. C. (Cape Fear River).
Mar. 16. On House bill 8974, Fifty-fifth Congress, second session, for the purchase of land at Rockaway Point, New York, for fortification purposes.
Mar. 16. On distribution of rapid-fire guns for Galveston, Tex.
Mar. 16. On distribution of rapid-fire guns and old armament for Key West, Fla.
Mar. 16. } Mar. 25. } On distribution of rapid-fire guns for Potomac River (Washington, D. C.).
Mar. 22. On advisability of procuring additional land for defensive purposes at Pensacola, Fla.
Mar. 22. On letters of Hon. R. E. Lester, M. C., First district of Georgia, and N. O. Tilton, of Wilmington, N. C., relative to defense of approach to Savannah, Ga., by means of Wilmington River.
Mar. 22. On submarine mine defense of Puget Sound.
Mar. 22. On distribution of rapid-fire guns for Port Orchard, Puget Sound.
Mar. 23. On use of a Gruson turret for defense of Dry Tortugas.
Mar. 25. On project of H. L. Davis, of Philadelphia, Pa., for defending and protecting rivers and harbors from hostile naval attack by the use of petroleum.
Mar. 25. } Mar. 26. } Preliminary report on artillery and submarine mine defense of Tampa, Fla.
Mar. 25. On the use of pneumatic dynamite guns as an adjunct to the means of coast defense.
Mar. 29. On letter from Lieut. Col. William Ludlow, Corps of Engineers, suggesting the equipment of Fort Hamilton for torpedo work.
Mar. 29. On letter from Lieut. Col. William Ludlow, Corps of Engineers, inviting attention to what he regards as a serious defect in the construction of the new 10 inch battery at Fort Hamilton.
Mar. 29. On letter from Col. R.T. Frank, commanding United States Artillery School, inviting attention to incompleteness of the armament at Fort Monroe.
Mar. 29. On mounts for 12-inch guns for Hampton Roads, Virginia.
Mar. 29. On distribution of rapid-fire guns and old armament for Hampton Roads, Virginia.
Mar. 29. On letter from Lieut. Col. William Ludlow, Corps of Engineers, inviting attention to the anchorage area west of Rockaway Inlet, New York, which might be used by a hostile fleet, and suggesting the mounting of guns on Plumb Island, or two 12-inch rifles at Fort Hamilton.
Apr. 1. On the artillery defense of St. Augustine, Fla.
Apr. 1. Relative to the submarine mine defense of the channels near Sandy Hook.

1898.
Apr. 1. On the defense of Boston at Deer Island.
Apr. 1. On the submarine mine defense of Key West, Fla.
Apr. 1. / Apr. 27. } On experimental chain ammunition hoist for 12-inch guns.
Apr. 5. On revised bracket hangers for pulleys of ammunition lift in 10-inch gun emplacement.
Apr. 5. On proposed purchase of a Pfund military bridge.
Apr. 5. / Apr. 14. } On revised design for emplacement for 8-inch B. L. R.
Apr. 7. On system of F. Jarvis Patten of torpedoes by the use of acetylene gas.
Apr. 12. On a device for coast defense proposed by M. C. Mengis.
Apr. 12. On proposed new magazines at Fort Hamilton, N. Y.
Apr. 19. On defense of the southern entrance to New York (Staten Island Kills).
Apr. 28. On the question of changing the existing form of mortar battery.
Apr. 30. On indorsement of the Engineer Department of April 25, 1898, referring for remark letter from Lieut. J. W. Ruckman, Seventh Artillery, relative to the influence of altitude of gun mounts, having special reference to location of R. F. guns at Fort Monroe, Va.
May 6. On the device of F. Jarvis Patten for torpedoes by the use of acetylene gas.
May 6. On location of rapid-fire guns at Fort Delaware as affecting the location of heavy guns.
May 6. On the use of range and position finders in seacoast fortifications.
May 9. On modification of 12-inch emplacements at Charleston, S. C.
May 26. On the prevention of dampness in magazines.
June 3. On design for a battery of eight mortars arranged in two pits open to the rear.
June 8. On letter from Maj. Smith S. Leach, Corps of Engineers, dated June 2, 1898, on installation of search lights at Great Gull Island.
June 18. On shelters and towers for range finders.
June 20. On letter from Maj. Smith S. Leach, Corps of Engineers, dated June 11, 1898, relative to proportions of certain mixtures for use in the prevention of dampness in magazines.
June 20. On indorsement of the Engineer Department, of June 15, 1898, referring for remark and recommendation letter from Lieut. Col. C. W. Raymond, Corps of Engineers, submitting suggestions relative to number and location of rapid-fire guns at Fort Delaware.
June 30. On indorsement of the Engineer Department, of June 25, 1898, referring for remark and recommendation letter from Capt. T. L. Casey, Corps of Engineers, submitting plans and estimates for 10-inch depressing gun at Fort Monroe, Va.

In the performance of its duties the Board made the following personal inspections of sites for defenses:

Under instructions of the Chief of Engineers, dated November 22, 1897, the Board, consisting of Colonel Gillespie, Majors Adams and Knight, and Captain Hodges, on December 10, 1897, inspected sites for the defense of Port Royal Sound. Colonel Robert, by reason of other public duties, was unable to join the Board at that time, but made a personal inspection of the locality in the latter part of that month.

Under instructions of the Chief of Engineers, dated December 9, 1897, the Board, consisting of Majors Adams and Knight and Captain Hodges, on December 21, 1897, inspected sites for the defense of Narragansett Bay. Colonels Robert and Gillespie were unable, by reason of other public duties, to join the Board at that time, but Colonel Robert made a personal inspection of the locality later in the month.

Under instructions of the Chief of Engineers, dated April 9, 1897, and January 15, 1898, the Board, consisting of Colonel Robert, Majors Adams and Knight, and Captain Hodges, on February 8, 9, and 10, 1898, visited the Dry Tortugas, Florida, in connection with the preparation of detailed projects for the artillery and submarine mine defense of that locality. Colonel Gillespie was unable, by reason of other public duty, to join the Board, but he had previously inspected the locality.

Under instructions of the Chief of Engineers, dated September 17, 1897, and January 15, 1898, the full Board, on February 12, 1898, visited

the mouth of the St. Johns River, Florida, in connection with the preparation of projects for the artillery and submarine mine defense of that locality.

In addition to their duties with The Board of Engineers, the individual members of the Board have been engaged as follows during the year ending June 30, 1898:

Col. Henry M. Robert, the president of The Board of Engineers, served as president and member of the following boards: 1. To provide for the examination and survey of a water route from the mouth of the jetties at Galveston, Tex., through the ship channel and up Buffalo Bayou to Houston, Tex. 2. To examine and report upon the character and value of improvements at the mouth of the Brazos River, Texas. 3. To examine and report upon the character and value of improvements made at Aransas Pass by the Aransas Pass Harbor Company. 4. To consider and report on project for the protection of the Sandy Hook peninsula and for the construction of a drawbridge over the Shrewsbury River, New Jersey. 5. To consider and report upon the modification of harbor lines at Bridgeport, Conn.; and 6. To examine officers of the Corps of Engineers with a view to their promotion.

He continues as Division Engineer of the Southwest Division, as exofficio member of the Board of Visitors for the United States Engineer School, and as president and member of the following boards (*a*) On harbor lines for the harbor of New York and its adjacent waters. (*b*) On harbor lines for the port of Philadelphia. (*c*) On the reconsideration of a project for the improvement of Pensacola Harbor, Florida. (*d*) On survey and report upon the navigable channel through Southwest Pass, Mississippi River. (*e*) Is under instructions from the Chief of Engineers to make a report on the resolution of the United States Senate, of May 19, 1898, relative to Aransas Pass, Texas; and (*f*) To examine officers of the Corps of Engineers with a view to their promotion.

Col. G. L. Gillespie, Corps of Engineers, has continued to serve as Division Engineer of the Northeast Division; member and president of the Mississippi River Commission; member of the Board of Visitors to the United States Engineer School; member of Boards of Engineer Officers to report upon harbor lines of New York Harbor and adjacent waters, and to reconsider the project for Pensacola Harbor, Florida; member of the Light-house Board, and, until June 3, 1898, member of the Board of Officers for the examination for promotion of officers of the Corps of Engineers.

He has also served as a member and president of a board of officers in connection with works of improvement at Savannah River and Cumberland Sound, Georgia, and as a member and president of a board of officers to examine applicants for commission in the First Regiment of United States Volunteer Engineers.

He was appointed brigadier-general of United States Volunteers, and accepted appointment June 4, 1898. He was assigned to the command of the Department of the East June 28, 1898, and assumed command of said department June 30, 1898.

Maj. Henry M. Adams, Corps of Engineers, is a member of the following boards: On harbor lines for the harbor of New York and its adjacent waters, and of Board of Engineer Officers for the revision of the existing torpedo system. He has continued in charge of defensive works at eastern entrance to New York Harbor; of works on islands in New York Harbor and on Staten Island, and of sea walls on Governors and Davids Islands, and of the various river and harbor improve-

ments of which he had charge at the end of the fiscal year ending June 30, 1897, with the exception of the following river and harbor works, the charge of which he transferred to Maj. A. M. Miller, Corps of Engineers, during October and November, 1897, under instructions from the Engineer Department: At Keyport, N. J.; the channel between Staten Island and New Jersey; the rivers Shrewsbury, Elizabeth, South, Raritan, and Passaic; Shoal Harbor and Compton Creek, and Mattawan, N. J.; Raritan Bay, N. J.; and reconstruction of the approaches to the draw of the Newark and Hudson River Railroad Bridge across the Passaic River, at Newark, N. J. During the past fiscal year he served as member of Board of Engineer Officers in connection with works of improvement of the Savannah River, Georgia, and Cumberland Sound, Florida; member of board for the construction of a drawbridge over the Shrewsbury River, and for the maintenance of navigation in that river; and member of the Board of Ordnance and Fortification during the absence of Col. P. C. Hains, Corps of Engineers, with the Nicaragua Canal Commission. He continues to supervise the construction of permanent and temporary bridges across Newtown Creek at Vernon avenue, Long Island City; of bridge across Mill Neck Creek Inlet from Allens Point at Mill Neck to Pine Island, at Bayville, N. Y.; of bridge over Coney Island Creek from West Seventeenth to West Eighteenth street, Brooklyn, N. Y.; of bridge over the Bronx River at Westchester avenue, New York City; and of bridge across the channel between City Island and Pelham Bay Park, in New York City. Under orders of the Chief of Engineers, on April 21, 1898, he relieved Lieut. Col. William Ludlow, Corps of Engineers, temporarily, of the following duties, and these works are now under his charge: Works on Long Island and Sandy Hook for the defense of the southern entrance to New York Harbor, and of sea walls on the north and east shore of Sandy Hook Peninsula. Improvement of the harbor of New York and the Harlem River; deepening Gedney Channel, and the removal of obstructions in East River at Hell Gate, N. Y. To supervise the construction of bridges across East River between the cities of New York and Long Island City, at Blackwells Island; and between the cities of New York and Brooklyn at Delancy street and near Scammel street, New York City; of bridges across the Harlem River at Forest avenue, at Third avenue, and between One hundred and forty-fifth and One hundred and forty-ninth streets, New York City; of temporary bridges across the Harlem River at Third avenue and One hundred and fifty-sixth street, New York City; reconstruction of bridge across Spuyten Duyvil Creek, New York; and of two piers on the Jersey Flats, New York Bay, at Bayonne, N. J.; in charge of the removal of the wrecked ship *Alvena* in New York Harbor.

Capt. H. F. Hodges has continued as disbursing officer of The Board of Engineers. Having been appointed Lieutenant-Colonel of the First Regiment of Volunteer Engineers, he has, by direction of the Secretary of War, been placed on duty in connection with the recruiting of that regiment, continuing at the same time his duties as a member of The Board of Engineers under the Chief of Engineers. He is also a member of a board for the examination of officers of the Corps of Engineers with a view to their promotion.

For the Board.

Very respectfully, your obedient servant,

HENRY M. ROBERT,
Colonel, Corps of Engineers, President of the Board.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

APPENDIX No. 2.

POST OF WILLETS POINT, NEW YORK—UNITED STATES ENGINEER SCHOOL—BATTALION OF ENGINEERS—ENGINEER DEPOT.

REPORT OF MAJ. JOHN G. D. KNIGHT, CORPS OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30, 1898.

UNITED STATES ENGINEER SCHOOL,
Willets Point, N. Y., August 4, 1898.

GENERAL: I have the honor to forward herewith duplicate annual report on the Post of Willets Point, N. Y., the United States Engineer School, the Battalion of Engineers, and the Engineer Depot, for the fiscal year ending June 30, 1898.

Very respectfully, your obedient servant,

JOHN G. D. KNIGHT,
Major, Corps of Engineers, Commanding.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

I.—POST OF WILLETS POINT, N. Y.

During the past fiscal year a brick mess hall has been erected, accommodating three companies in separate messes. Its cost was $18,724.36. Repairs to buildings and post wharf were made, most of the labor being performed by soldiers.

Allotments for new structures and for labor and materials for repairs have been received as follows:

Mess hall:		
Construction	$17,000.00	
Plumbing	675.00	
Heating apparatus	1,049.36	
		$18,724.36
Barracks and quarters		3,245.00
Heating apparatus		932.00
Plumbing and teamsters		1,623.10
Labor		2,100.00
Repairs to wharf		3,010.00
Total		29,634.46

The current expenditures for repairs were about $200 less than for the previous year.

The post had been connected with Whitestone Landing by telegraph through a cable. This cable having deteriorated, a land wire was set

up from Whitestone to the reservation boundary by the Western Union Telegraph Company, the necessary permission from local authorities having been obtained. The cost of erecting the line, $250, was paid from the appropriation for contingencies of the Army. The line was extended to the headquarters building by Government labor and material.

Two operators are detailed from the Battalion of Engineers and receive no extra pay for their services as operators, either from the United States or the Western Union Company.

The garrison of the post has consisted of headquarters band, Companies A, B, and C, Battalion of Engineers, a detachment of the hospital corps, and of various organizations given in details below.

Battery M, Fifth Artillery, arrived July 1 and departed July 3, 1897, having been engaged in artillery target practice.

Battery M, Fifth Artillery, arrived October 9 and remained in camp until November 10, 1897, having been engaged in mounting an 8-inch gun and carriage.

A detachment of Batteries K and L, Fifth Artillery, under command of Lieut. Clarence E. Lang, was present from February 19 until June 2, 1898, mounting gun and mortars.

Batteries K and L, Seventh Artillery, have been encamped on the post since May 18.

Forty-eight enlisted men from Company E, Battalion of Engineers, were present from April 1 to April 20, 1898, receiving instruction in submarine mining.

Company G, Twenty-second New York Volunteer Infantry, reported for special duty under the post commander on June 10, 1898. This company is quartered in the barrack recently vacated by Company A, Battalion of Engineers.

The Third Battalion of the Twenty-second New York Volunteer Infantry, Maj. G. D. Russell, commanding, reported for duty as infantry support on June 10, 1898, and is encamped upon the space north of the north row of officers' quarters.

Detachments of enlisted men from the various engineer companies have left the post from time to time, beginning April 5, until now 153 men are detached at 19 harbors throughout the country, and performing the skilled labor required in planting and operating submarine mines.

The demands made upon the battalion for the performance of other technical duties minimized these detachments below the numbers required for prompt results and necessitated the employment of civilians not so well qualified as are specially trained solders, and with increased expense to the Government.

From April 1 to April 20, 1898, 50 men from Company A, Battalion of Engineers, were at West Point, N. Y., to enable an equal detachment of Company E to take a course of instruction in submarine mining at this post.

On May 14, 1898, Company C, Battalion of Engineers, left en route for Tampa, Fla.

On May 24, 1898, Company A, Battalion of Engineers, left en route for San Francisco and the Philippines.

June 30, 1898, the garrison of the post consisted of Company B and part of Company D, Battalion of Engineers; Batteries K and L, Seventh Artillery, and Companies D, F, G, L, and M, Twenty-second New York Volunteer Infantry.

Besides the officers attached to troops, the following have been stationed at the post during the year:

Maj. H. S. Turrill, Surgeon.
Capt. J. D. Poindexter, Assistant Surgeon, relieved November 8, 1897.
Capt. Ogden Rafferty, Assistant Surgeon, joined November 8, 1897, and relieved June 4, 1898.

Detailed for instruction in submarine mining at the United States Engineer School, under paragraph 346, Army Regulations:

First Lieut. William H. Wilhelm, Fourteenth Infantry, joined November 1, 1897.
First Lieut. William O. Johnson, Tenth Infantry, joined November 1, 1897.
Second Lieut. Harry J. Hirsch, Fifteenth Infantry, joined November 1, 1897.
Second Lieut. Robert L. Hamilton, Twenty-second Infantry, joined November 1, 1897.
Second Lieut. John S. Murdock, Twenty-fifth Infantry, joined November 1, 1897.
Second Lieut. Arthur M. Edwards, Third Infantry, joined November 1, 1897.
Second Lieut. Frederick G. Stritzinger, Twenty-third Infantry, joined November 1, 1897.
Second Lieut. Joseph S. Herron, First Cavalry, joined November 1, 1897.
Second Lieut. Walter S. McBroom, Eighteenth Infantry, joined November 1, 1897.
Second Lieut. Oscar J. Charles, Tenth Infantry, joined November 1, 1897.

On account of the war with Spain, all of the above-named officers were relieved from duty April 21, 1898.

Second Lieut. William J. Johnston, Tenth Cavalry, relieved August 18, 1897.
Second Lieut. Frank A. Wilcox, First Infantry, relieved August 18, 1897.
Second Lieut. William C. Rogers, Seventh Infantry, relieved August 18, 1897.
Second Lieut. Frank B. McKenna, Fifteenth Infantry, relieved August 18, 1897.
Second Lieut. William A. Raibourn, Fourth Infantry, relieved August 18, 1897.

II.—UNITED STATES ENGINEER SCHOOL.

COMMANDANT.

Maj. John G. D. Knight, Corps of Engineers.

This school, having been in operation about nineteen years, was reorganized on a basis given on pages 474–477, Annual Report of the Chief of Engineers, United States Army, 1886. New "Regulations for the Government of the U. S. Engineer School" were approved by the Secretary of War, and published November 11, 1897, as follows:

GENERAL ORDERS, No. 63.

HEADQUARTERS OF THE ARMY,
ADJUTANT-GENERAL'S OFFICE,
Washington, November 11, 1897.

The following regulations for the government of the United States Engineer School at Willets Point, New York, have been approved by the Secretary of War, and are by his direction published for the information and guidance of all concerned.

By command of Major-General Miles:

SAMUEL BRECK,
Adjutant-General.

REGULATIONS FOR THE UNITED STATES ENGINEER SCHOOL.

1. The school is officially designated as the United States Engineer School.

2. *Object.*—The object of the school is to increase the professional qualifications of officers assigned to the Corps of Engineers; to conduct researches in the branches of science applicable to the duties of that Corps; and to prepare manuals of instruction and guidance for duties required of engineer officers and soldiers.

3. *Command.*—The School, under the Chief of Engineers, shall be under the command of the officer of the Corps of Engineers assigned to the command of the post at Willets Point, New York.

4. *Academic Staff.*—The Academic Staff shall consist of the Commandant and Instructors.

The Adjutant shall be the Secretary of the Staff.

5. *Departments of Instruction.*—There shall be three departments of instruction, as follows:

a. Military Engineering.
b. Electrical Engineering.
c. Civil Engineering.

Each department will be in charge of an instructor assigned by the Commandant from among the captains commanding the engineer companies on duty at Willets Point.

6. *Students.*—The students shall be the junior engineer officers on duty with the Battalion of Engineers at Willets Point and such other officers as may be attached to the School for special instruction.

7. *Period of Instruction.*—Engineer officers shall be under instruction for two years, beginning October first.

The period for essentially theoretical instruction (the winter course) shall extend from November first to May first; that for essentially practical instruction (the summer course) from May first to November first.

8. *Method of Instruction.*—Practical work, as well as subjects for study, research, and themes, will be assigned to the student officers by the instructors, who also will indicate the sources of information. During the winter course instructors will meet their classes at least weekly for the purpose of consultation and for the oral examination of student officers.

Where these examinations indicate unsatisfactory progress, report thereof shall be made without delay to the Commandant.

Written, and, if required by the Commandant, oral and practical, examinations shall be held in each department of instruction, at the conclusion of instruction in that department, and also upon the temporary suspension of theoretical instruction, in case instruction in any department should continue for more than one season.

Oral examinations, other than weekly, shall be in the presence of the Academic Staff. From the examinations, and from the results as shown by the practical work, the student engineer officers shall be classified in each department by the Academic Staff as proficient with honor, proficient, or deficient. This classification shall be based on the examinations and shall be made of record.

The degree of proficiency in the case of others than engineer officers taking the submarine mining course shall be indicated as follows:

Qualified to take entire charge of the submarine mine defense of a harbor.
Qualified to take charge of casemate work and planting mines.
Qualified to take charge of planting mines.

9. *Diplomas.*—Diplomas signed by the Academic Staff shall be given to all officers who complete the entire course of instruction to the satisfaction of the Staff.

Officers who, on account of ill-health or the exigencies of the service, have been unable to complete the entire course, will receive diplomas indicating the subjects they have satisfactorily completed.

Should an officer be examined for promotion within two years from the date of his diploma, the diploma shall be accepted by the Examining Board as sufficient evidence of the proficiency of the officer in the subjects indicated as satisfactorily completed.

10. *Board of Visitors.*—The Board of Visitors shall consist of the President of The Board of Engineers, and two officers of the Corp of Engineers to be designated by the Chief of Engineers. The Board shall visit the School annually, soon after the close of the winter course, and make a thorough and detailed inspection of everything connected with it. It shall submit a report of its inspection to the Secretary of War, through the Chief of Engineers, with such recommendations in reference to the School as may be deemed necessary.

11. *Programme of Instruction.*—The following shall be the general programme of instruction, of which the details shall be ordered by the Commandant, upon the recommendation of the Academic Staff:

Military Engineering.—Service manuals; reconnaissances of routes and positions; maps, plans, and military photography; explosives; military bridges; campaigns; land and coast defenses, their plans, estimates, general methods of construction, armament, attack and defense.

Electrical Engineering.—Service manual; the application of electricity to seacoast and land defenses, and transmission of power.

Civil Engineering.—Surveying and practical astronomy; preliminary examinations of navigable waterways; river and harbor improvements; detailed study of building materials, plant, and methods of construction, particularly as applied in fortifications, river and harbor works, and their accessories.

The courses of instruction will be supplemented by lectures by officers of the Army and Navy and civilians, as well as by visits to manufacturing establishments and to important works of civil and military engineering.

12. *Application of Time.*—Reconnaissance work in the field shall be executed during the first month of duty at the School.

Of the first winter course the first sixteen weeks shall be applied to instruction in electrical engineering, and nine weeks to instruction in civil engineering.

Of the second winter course, the first eleven weeks shall be applied to instruction in civil engineering, and fourteen weeks to instruction in military engineering.

During the summer courses practice shall be had in preliminary examinations and surveys, practical astronomy, electrical engineering, and other instrumental work.

13. *Monthly Reports.*—The instructors shall submit monthly reports of the operations of their departments to the Commandant, who shall submit monthly reports of the operations of the School to the Chief of Engineers.

14. *Annual Reports.*—The instructors shall annually, and within thirty days after the close of the winter season, submit to the Commandant a report of the operations of their respective departments during the preceding year, which report shall include in detail the subjects for study and research assigned during that year, the practical work executed, and all other matters pertaining to their departments worthy of record on the School files. The Commandant shall annually and within twenty days after the close of each fiscal year, submit to the Chief of Engineers a detailed report of the operations of the School.

15. *Disbursements.*—All funds appropriated specially for furthering the object of the School shall be disbursed by the Commandant.

16. *Cooperation of Troops.*—The Commandant as Post Commander will so arrange the duties of the troops of his command as to comply most effectively with the spirit of these Regulations.

17. *Tours of Duty.*—Subject to the exigencies of the service, the regular tour of duty of members of the Academic and Battalion Staff shall be not less than three years; all graduates of the Military Academy, assigned to the Corps of Engineers, shall be ordered to duty at the School, commencing one year after the expiration of their graduating leave, or at such other date as the interests of the service may require, and continuing not less than two years.

The principal changes effected are two, the shortening of the course of instruction of engineer officers from three years to two years; when an officer is to be examined for promotion within two years from the date of his diploma, causing this diploma to be accepted by the examining board as sufficient evidence of the proficiency of the officer in the subjects indicated therein as satisfactorily completed.

Summaries of the work of the different instructors are as follows:

A.—Military Engineering.

Instructor: Capt. Graham D. Fitch, Corps of Engineers.

The second winter's course of instruction in military engineering began January 24, 1898. The officers under instruction were Second Lieuts. E. H. Schulz and Harry Burgess, Corps of Engineers.

The entire course of fourteen weeks was not completed, as the then approaching war with Spain caused a suspension of school work on April 4, 1898. The following were the subjects of study: Modern guns and mortars and their appropriate carriages; coast fortifications and attack and defense of same; explosives and military mining; bridges, field works, etc.

B.—Electrical Engineering.

Instructor: Capt. W. C. Langfitt, Corps of Engineers.

During the summer season practice in loading and planting submarine mines occupied the cavalry and infantry officers detailed here for instruction, the necessary assistance being rendered by enlisted men from the Battalion of Engineers. Second Lieutenants Schulz and Burgess, Corps of Engineers, attended these operations with their respective companies.

From November 1, 1897, until March 2, 1898, there were under instruction the engineer officers of the first winter's class, Second Lieut. E. R. Stuart, and Additional Second Lieut. G. M. Hoffman, Corps of Engineers; and from November 1, 1898, until they were relieved at

their own requests from duty at this post, April 21, 1898, on account of the impending war with Spain, there were under instruction the following officers specially detailed for the course:

First Lieut. W. H. Wilhelm, Fourteenth Infantry.
First Lieut. W. O. Johnson, Seventh Infantry.
Second Lieut. H. J. Hirsch, Fifteenth Infantry.
Second Lieut. R. L. Hamilton, Twenty-second Infantry.
Second Lieut. J. S. Murdock, Twenty-fifth Infantry.
Second Lieut. A. M. Edwards, Third Infantry.
Second Lieut. F. G. Stritzinger, Twenty-third Infantry.
Second Lieut. J. S. Herron, First Cavalry.
Second Lieut. W. S. McBroom, Eighteenth Infantry.
Second Lieut. O. J. Charles, Tenth Infantry.

Student officers were continuously engaged in practical laboratory work, making electrical tests and measurements, in theoretical electrical studies and problems, and in submarine mining work.

A number of lectures were delivered by the instructor, and a comprehensive written examination was held on March 1, 1898.

C.—Civil Engineering.

Instructor: Capt. S. W. Roessler, Corps of Engineers.

The officers of the second winter's class were Second Lieuts. E. H. Schulz and Harry Burgess, Corps of Engineers. The officers of the first winter's class were Second Lieut. E. R. Stuart and Additional Second Lieut. G. M. Hoffman, Corps of Engineers.

The following extracts from the report of the instructor are of special interest:

In September, 1897, Lieutenants Schulz and Burgess completed a topographical survey of about 1 square mile of territory in the vicinity of Little Neck, Long Island.

The theoretical course of the second winter's class was commenced November 1, 1897, and continued eleven weeks. The method of instruction was as follows:

The instructor and student officers met at least once each week, usually at its close, to discuss the subject under investigation that week and to announce the subject for the following week. Text-books were not mentioned and each officer had full liberty to acquire his information wherever he pleased. No marks were awarded as the result of the weekly meeting, but instead a remark was entered opposite each officer's name, indicating the degree of zeal and ability displayed by him in his week's investigation. The officers were impressed with the fact that the instructor desired to conduct the course and the weekly meetings on principles as different as possible from the text-book and recitation systems; that they should not work for marks, as there would be none; nor study a subject with a special view of making a showing of knowledge before the instructor, but rather store up in their minds or notebooks, or both, as much useful information as they could gather within the few days allotted to the subject.

* * * * * * *

The course of the second winter's class, which comprised eleven weeks, included the following subjects:

(1) Preliminary examination of navigable waterways.

(2) Preparation of an estimate of cost for surveying a canal route to connect the James River at Richmond, Va., with the Great Kanawha River at the head of slackwater navigation.

(3) River regulation in general and that of the James River in particular.

(4) Canalization of rivers as illustrated by that of the Great Kanawha River.

(5) Canal construction and location as illustrated by that of the Illinois and Mississippi Canal.

(6) Lake breakwaters in general, including a rather detailed study of the Buffalo Breakwater.

(7) (Two weeks) Cement and cement testing, including laboratory practice in making and breaking briquets, including also the preparation of a suitable design for a wharf to receive and rapidly handle the materials required in the construction of a modern fort, and to have sufficient strength to receive and convey a 10-inch gun and carriage.

(8) Improvement of an entrance to a harbor on a sandy coast as exemplified by that at Galveston, Tex.

(9) (Two weeks) Steam engines and steam engineering.

* * * * * * *

The course of nine weeks for the officers of the first winter's class commenced March 2, 1898, but was discontinued after the fifth week of study on account of war preparations. The class consisted of Lieutenants Stuart and Hoffman. The subjects studied were as follows:

(1) Preliminary surveys, and examinations, instruments, and method used; information to be collected and preparation of report.

(2) Suitable organization of a survey party for surveying the location of a canal, including the estimate of cost of surveying the James River and Kanawha Canal route.

(3) Topographical surveying; instruments and methods used; organization of party; cost.

(4) Hydrographic surveying, including gauging of rivers and tidal currents. Instruments; methods; cost.

(5) Cement and cement testing.

The latter subject was just begun when the course was suspended.

Astronomy and Military Photography.

Separate departments for instruction in these subjects existed until the new regulations were published. The courses of instruction are stated on pages 568 and 569, Annual Report of the Chief of Engineers, United States Army, 1897.

Between July 1 and November 30, 1897, Additional Second Lieuts. G. M. Hoffman and F. W. Altstaetter, Corps of Engineers, completed the practical work of the course in photography, First Lieut. E. W. Van C. Lucas, Corps of Engineers, acting as instructor.

The course in astronomy for the first summer's class, Second Lieuts. E. H. Schulz and Harry Burgess, Corps of Engineers, was completed in August, 1897, the computations being turned in two months later. First Lieut. W. V. Judson, Corps of Engineers, acted as instructor.

Special Details of Officers for Instruction in Submarine Mining.

Special details of officers, other than engineer officers, for instruction at this school in submarine mining were first authorized in 1880. After an experience of eighteen years, the pending war has furnished an opportunity to determine what profit the United States derives from these details.

At the outbreak of war the ten officers under special instruction at once applied for orders to join their regiments. One officer on the Pacific coast, anticipating inaction there, proffered his services in submarine mine defense on the Atlantic coast; the services of one other were also utilized.

The benefit to the Government of this special instruction has been decidedly disproportionate to the large amount of labor which it requires of the instructor in electricity, and even to the mere expense of mileage involved by the changes of stations of officers. The service would have benefited more for these eighteen years by the presence with their companies of the officers absent on these details.

I have no hesitation in recommending therefore that Article XLII of the Army Regulations be annulled.

III.—BATTALION OF ENGINEERS.

April 4, 1898, the Secretary of War authorized the increase of the Battalion of Engineers from 500 to 702 enlisted men. Companies A, B, and C had previously had a total enlisted strength of 400 men, and Company D was a skeleton company.

Each of these companies was authorized to have an enlisted strength of 150 men.

Under authority given by section 3 of an act of Congress approved April 26, 1898, the organization of each engineer company of the battalion was on April 27, 1898, ordered as follows: One first sergeant, 10 sergeants, 10 corporals, 2 musicians, 64 first-class privates, and 63 second-class privates; total, 150.

This law modified section 1155, Revised Statutes, only by providing 1 first sergeant for each company and taking away from it 1 second-class private.

Under existing authority, 1 sergeant and 20 enlisted men are detached from the companies to constitute a band. These men are taken, as nearly as practicable, equally from the five companies, the sergeant being detached from Company D, and 3 first-class privates and 1 second class from each company.

Detachments for submarine-mine defense of harbors had been sent during April, 1898, from the three companies stationed here. As these companies were to be held in readiness for field service, it was desirable to have their strength the maximum possible. The opportunity to obtain this was given by the reorganization of Company D, to which company were transferred nearly all the detachments referred to. Its commanding officer and 12 men remain here, the men being quartered and messing with Company B.

Shortly after the departure of companies for Tampa and San Francisco, it became evident that company commanders would be seriously hampered in the administration of their companies if it continued necessary for them under the regulations to submit to the battalion commander, for his action, all recommendations as to appointment and reduction of enlisted men. Accordingly relief for these commanders was sought by me, and was obtained in General Orders, No. 82, Headquarters of the Army, June 27, 1898, of which Section II. provides—

During the existing war the commanding officers of engineer companies who are serving with their companies away from the headquarters of the Battalion of Regular Engineers are authorized to appoint sergeants, corporals, and first-class privates of their companies, and, when necessary, to reduce such enlisted men to the lower grades. This authority, however, will not affect the status of enlisted men who are not serving with these companies.

Until April, 1898, only some of the noncommissioned officers of the Company (E), stationed at West Point, had received instruction in submarine mining. During that month 48 men of Company E reported at this station, having been replaced at West Point by a detachment of Company A. After instruction the men were returned to their respective stations, but war prevented extending the instruction to the remainder of Company E.

Three companies of the battalion having taken the field, and one being mainly scattered along the seacoast, and the summary court having been temporarily suspended, it is impracticable to continue the comparative tables, presented in previous reports, giving statistics relating to recruiting, discipline, etc., and to now furnish a roster of officers serving with the battalion.

IV.—ENGINEER DEPOT.

The usual routine care of property pertaining to the depot has continued, the labor incident thereto having been performed by enlisted men of the Engineer Battalion. Since June 10, 1898, Company G,

Twenty-second United States Volunteer Infantry, has assisted in receiving and shipping property.

The charge of the depot is distinct from the command of the post of Willets Point or of the Battalion of Engineers, but under date of March 15, 1898, the Secretary of War directed the commanding officer of the post to aid the officer in charge of the Engineer Depot at Willets Point, N. Y., as far as possible, with the services of the officers and enlisted men of his command, when so requested by the officer in charge of the depot.

The Secretary of War directed at the same time that the officer in charge of the Engineer Depot be authorized to order any officer or officers assisting him to go to any point in the vicinity where his or their services might be required in connection with the purchase or inspection of submarine-mining materials, paying his or their travel expenses and mileage from the proper appropriation.

The roundhouse (modeling room) has been converted temporarily into a storeroom for submarine-mining and siege supplies.

Models of and photographic transparent views of works of civil and military engineering and specimens of submarine mining were sent to the Omaha Exposition, where they now are in the immediate charge of a corporal of the Battalion of Engineers.

Additions to the library were made as heretofore by purchase and subscription, and by the receipt of volumes from other institutions and from official sources in Washington, D. C.

Shipments of bridge equipage have been made as follows: One hundred and forty-five feet of reserve and 310 feet of advance guard, without wagons except 2 tool wagons, were transferred to Company E for field use; and 305 feet of reserve train, with no wagons except 2 tool wagons, were started to Tampa, Fla. This last reserve train left the wharf four hours after the arrival of the steam lighter taking it and about thirty-one hours after notice to prepare it.

One reserve and three advance guard divisions are in course of preparation.

Engineer equipment, including tools and siege material sufficient for a working party of 30,000 men, not including reliefs, has been purchased. Besides ordinary material, a limited number of sap shields have been obtained, and of soft steel-plate gabions have been ordered for delivery in July.

INSTRUMENTS.

These have mainly been obtained as heretofore—on quotations holding for the fiscal year.

Besides ordinary issues and receipts, other issues of surveying, reconnaissance, and photographic instruments have been made to corps and division engineers. The need of some standard, both as regards articles and quantities, has been felt, and delay in filling requisitions has resulted from calls for instruments not ordinarily on the market. The limited demand for various articles in time of peace found no available sufficient supply at the outbreak of war.

SUBMARINE-MINING MATERIAL.

March 18, 1898, I was charged with the expenditure of $225,000 from the appropriation for "National Defense," and April 2, 1898, with the expenditure of the additional sum of $945,000, alloted for various purposes, as shown in the money statement below.

By about the end of June, seven manufacturers had delivered 153 miles of multiple and 306 miles of single-conductor cable. Orders were placed for 1,158 buoyant and 500 ground-mine cases, with the necessary anchors for the former.

Thirty-two search-light outfits were obtained by June 23, and eight more by July 19, 1898; of these, five were 24-inch, twenty-four were 30-inch, and eleven were 36-inch. In all cases where time permitted, oil engines to drive the dynamo formed part of these outfits; in others, steam engines. Each outfit was provided with a truck on which to transport the projector and controller, and with a reel to carry at least 1,000 feet of connecting cable.

Outfits for 18 mining casemates were provided to supplement those for 26 casemates previously provided during the year with the regular appropriation.

Many miscellaneous supplies accessory to the larger articles mentioned were obtained and distributed.

As a rule, cable, anchors, mine cases, search lights, engines, and transformers were shipped direct from factories, but other articles came here either for test or distribution, or both.

The work of receiving and shipping has been very laborious. It has been performed by enlisted men of the battalion by day and very often well into the night. These deserve the greater credit, as this duty prevented them from accompanying their comrades into the field.

The noncommissioned officer in immediate charge of the property of the depot, Sergt. Charles M. Beer, Company B, Battalion of Engineers, merits special mention for performing his duties with fidelity, accuracy, and unflagging zeal, without regard for hours or days.

TORPEDO EXPERIMENTS.

These were carried on by Capt. William C. Langfitt, during the greater part of the year in connection with his duties as member of the Torpedo Board, and resulted in that officer's developing many improvements on the system of mine defense previously adopted.

The Board on Torpedo System was instructed, July 11, 1896, to purchase and test a torpedo of the design of Lieutenant Halpine, United States Navy (retired), and submit report thereon.

A torpedo was landed here by Lieutenant Halpine, April 22, 1898, but on July 12, 1898, a request was received that the torpedo might be stored at inventor's risk at present, until he can communicate with the Board of Ordnance and Fortification as to new specifications.

STATEMENT OF FUNDS.

I. *Engineer Depot at Willets Point, N. Y.*—Congress appropriated for the fiscal year ending June 30, 1898:

1. For incidental expenses of depot (incidentals)	$5,000.00
2. For purchase of materials for use of United States Engineer School and instruction of engineer troops (materials)	1,500.00
3. For purchase and repair of instruments (instruments)	3,000.00
4. For library of the United States Engineer School—For purchase and binding of professional works of recent date treating of military and civil engineering (library)	500.00
Total	10,000.00

Of this, there has been expended and pledged:

1. For incidental expenses of depot (incidentals)	$4,397.82
2. For purchase of materials for use of United States Engineer School and instruction of engineer troops (materials)	1,108.55
3. For purchase and repair of instruments (instruments)	2,968.46
4. For library of the United States Engineer School—For purchase and binding of professional works of recent date treating of military and civil engineering (library)	383.14
Total	8,857.97
Balance unexpended, to be turned into the Treasury	1,142.03

II. *Torpedoes for Harbor Defense.*—The following allotments from the above appropriation were made from time to time, and are available until expended:

1. Act August 18, 1890, for torpedo experiments and instruction of engineer troops in submarine mining—		
July 1, 1897, balance unexpended		$3,052.24
June 30, 1898, amount expended during fiscal year	$1,860.84	
February 16, 1898, withdrawn	100.00	
		1,960.84
July 1, 1898, balance unexpended		1,091.40
July 1, 1898, outstanding liabilities		26.54
July 1, 1898, balance available		1,064.86
2. Act June 6, 1896, for purchase of submarine mining materials and necessary appliances—		
July 1, 1897, balance unexpended		5,749.23
June 30, 1898, amount expended during fiscal year		5,735.12
July 1, 1898, balance unexpended		14.11
July 1, 1898, outstanding liabilities		1.37
July 1, 1898, balance available		12.74
3. Act March 3, 1897, for purchase of submarine mining materials, etc., as recommended by the Board on Existing Torpedo System—		
July 1, 1897, balance unexpended		75,000.00
June 30, 1898, amount expended during fiscal year		68,016.26
July 1, 1898, balance unexpended		6,983.74
July 1, 1898, outstanding liabilities		4,459.27
July 1, 1898, balance available		2,524.47

III. "*National Defense*" *act of March 9, 1898.*—Under the above act the following allotments were assigned to me by the Chief of Engineers, United States Army, for the purchase of torpedo material and for materials for equipment of engineer troops, under item 1, Army Regulations, 566:

A. For Torpedo Defense.

1. March 18, 1898, for submarine cable	$119,000.00	
April 5, 1898, for submarine cable	219,000.00	
		$338,000.00
June 30, 1898, amount expended during fiscal year		334,945.13
July 1, 1898, balance unexpended		3,054.87
July 1, 1898, outstanding liabilities		3,032.55
July 1, 1898, balance available		22.32

2. March 18, 1898, for casemate outfits and operating apparatus		$29,000.00
June 30, 1898, amount expended during fiscal year		13,598.95
July 1, 1898, balance unexpended		15,401.05
July 1, 1898, outstanding liabilities		15,401.05
3. March 18, 1898, for circuit closers, circuit regulators, and plugs for 1,500 torpedoes		27,000.00
June 30, 1898, amount expended during fiscal year		21,972.25
July 1, 1898, balance unexpended		5,027.75
July 1, 1898, outstanding liabilities		5,027.75
4. March 18, 1898, for electric search lights with power installations		50,000.00
June 30, 1898, amount expended during fiscal year		38,195.00
July 1, 1898, balance unexpended		11,805.00
July 1, 1898, outstanding liabilities		11,750.00
July 1, 1898, balance available		55.00
5. April 5, 1898, for circuit closers and regulators		20,000.00
July 1, 1898, balance unexpended		20,000.00
July 1, 1898, outstanding liabilities		19,952.50
July 1, 1898, balance available		47.50
6. April 5, 1898, for compound plugs		40,000.00
July 1, 1898, balance unexpended		40,000.00
July 1, 1898, outstanding liabilities		6,272.25
July 1, 1898, balance available		33,727.75
7. April 5, 1898, for casemate outfits, operating apparatus, etc		21,000.00
June 30, 1898, amount expended during fiscal year		19,016.80
July 1, 1898, balance unexpended		1,983.20
July 1, 1898, outstanding liabilities		1,983.20
8. April 5, 1898, for search-light outfits complete		275,000.00
July 1, 1898, balance unexpended		275,000.00
July 1, 1898, outstanding liabilities		185,031.46
July 1, 1898, balance available		89,968.54
9. April 5, 1898, for submarine mines		200,000.00
June 30, 1898, amount expended during fiscal year		96,673.00
July 1, 1898, balance unexpended		103,327.00
July 1, 1898, outstanding liabilities		100,587.00
July 1, 1898, balance available		2,740.00
10. April 5, 1898, for cable and other apparatus for new mine		170,000.00
May 12, 1898, withdrawn	$10,000.00	
June 30, 1898, amount expended during fiscal year	54,012.24	
		64,012.24
July 1, 1898, balance unexpended		105,987.76
July 1, 1898, outstanding liabilities		105,987.76
11. May 27, 1898, for explosives		3,426.80
June 13, 1898, withdrawn	$0.80	
June 30, 1898, amount expended during fiscal year	3,426.00	
		3,426.80

B. For Equipment of Engineer Troops.

12. May 12, 1898, for repairing and completing ponton train	$10,000.00
June 30, 1898, amount expended during fiscal year	1,966.81
July 1, 1898, balance unexpended	8,033.19
July 1, 1898, outstanding liabilities	8,033.19
13. May 12, 1898, for nine Berthon folding ponton boats	1,000.00
July 1, 1898, balance unexpended	1,000.00
July 1, 1898, outstanding liabilities	837.02
July 1, 1898, balance available	162.98
14. May 12, 1898, for tools and instruments to equip Battalion of Engineers for field duty	3,000.00
June 30, 1898, amount expended during fiscal year	567.81
July 1, 1898, balance unexpended	2,432.19
July 1, 1898, outstanding liabilities	2,432.19

SUMMARY OF ALLOTMENTS FROM APPROPRIATION FOR "NATIONAL DEFENSE."

A. For Torpedo Defense.

Total of allotments		$1,173,426.80
Total of expenditures to June 30, 1898	$581,839.37	
Amounts withdrawn	10,000.80	
		591,840.17
July 1, 1898, balance unexpended		581,586.63
July 1, 1898, outstanding liabilities		455,025.52
July 1, 1898, balance available		126,561.11

B. For Equipment of Engineer Troops.

Total of allotments	14,000.00
Total of expenditure to June 30, 1898	2,534.62
July 1, 1898, balance unexpended	11,465.38
July 1, 1898, outstanding liabilities	11,302.40
July 1, 1898, balance available	162.98

IV. "*Torpedoes for Harbor Defense, January 1, 1899*" (*act of May 4, 1898*).—From the deficiency appropriation act approved May 4, 1898, the following allotment was assigned to me for disbursement, to enable me to settle accounts for cable and other submarine mining material as may be referred to me by district officers:

May 14, 1898, amount allotted	$25,000.00
June 30, 1898, amount expended during fiscal year	23,461.70
July 1, 1898, balance unexpended	1,538.30
July 1, 1898, outstanding liabilities	304.59
July 1, 1898, balance available	1,233.71

V. "*Equipment of Engineer Troops, January 1, 1899*" (*act of May 4, 1898*).—From the deficiency appropriation act approved May 4, 1898, the following allotments were assigned to me for disbursement, to procure ponton boats and materials, instruments, and intrenching and sappers' and miners' tools, as follows:

1. May 18, 1898, for ponton boats and materials	$12,000.00
July 1, 1898, balance unexpended	12,000.00
July 1, 1898, outstanding liabilities	12,000.00

2. May 18, 1898, for instruments	$10,000.00
June 30, 1898, amount expended during fiscal year	3,394.78
July 1, 1898, balance unexpended	6,605.22
July 1, 1898, outstanding liabilities	6,605.22
3. May 18, 1898, for intrenching and sappers' and miners' tools	23,000.00
June 30, 1898, amount expended during fiscal year	288.94
July 1, 1898, balance unexpended	22,711.06
July 1, 1898, outstanding liabilities	22,711.06

NEW APPROPRIATIONS.

The following items have been appropriated for the Engineer Depot at Willets Point, N. Y., for the fiscal year ending June 30, 1899, by the act approved March 15, 1898:

1. For incidental expenses of depot (incidentals)	$5,000.00
2. For purchase of materials for use of United States Engineer School and for instruction of engineer troops (materials)	1,500.00
3. For purchase and repair of instruments (instruments)	3,000.00
4. For Library of United States Engineer School: For purchase and binding of professional works of recent date, treating of military and civil engineering (library)	500.00
5. For construction of fireproof instrument-repair shop	8,000.00
6. For completion of reserve train of bridge equipage now in store at Willets Point	18,000.00
Total	36,000.00

ESTIMATES.

I. There will be required for the fiscal year ending June 30, 1900, the following for the Engineer Depot at Willets Point, N. Y.:

1. For incidental expenses of the depot, including fuel, lights, chemicals, stationery, hardware; extra-duty pay to soldiers necessarily employed for periods not less than ten days as artificers on work in addition to and not strictly in the line of their military duties, such as carpenters, blacksmiths, draftsmen, printers, lithographers, photographers, engine drivers, teamsters, wheelwrights, masons, machinists, painters, overseers, laborers; repairs of, and for materials to repair, public buildings and machinery, and unforeseen expenses	$5,000.00
2. For the purchase of materials for use of United States Engineer School and for instruction of Engineer Troops at Willets Point in their special duties as sappers and miners; for land and submarine mines, pontoniers, torpedo drill, and signaling	1,500.00
3. For purchase and repair of instruments, to be issued to officers of the Corps of Engineers and to officers detailed and on duty as acting engineer officers, for use on public works and surveys	3,000.00
4. For library of the United States Engineer School: For purchase and binding of professional works of recent date, treating of military and civil engineering and kindred scientific subjects	500.00
Total	10,000.00

II. There will be required for the investigation of points still unsettled in the submarine service and for the purchase of such materials as are necessary therefor the following:

1. For continuing torpedo experiments at Willets Point, N. Y. This appropriation to be available until expended.	$5,000.00

Remark under Paragraph II, item 1.—No appropriation for this purpose has been made since August 18, 1890, when the sum of $30,000 was appropriated jointly for torpedo experiments and instruction for

engineer troops in submarine mining. Of this appropriation but $1,064.86 remains available July 1, 1898, and will be expended before another appropriation is made.

ABSTRACTS OF PROPOSALS.

1. *For furnishing 30 miles single-conductor cable and 9 miles seven-core cable, opened July 6, 1897, by Maj. John G. D. Knight, Corps of Engineers, U. S. A., at Willets Point, N. Y.*

No.	Name and address of bidder.	Price per mile for single.	Price per mile for seven-core.	Total of bid.
1	Safety Insulated Wire and Cable Co., New York, N. Y	$403.50	$1,423.50	$24,916.50
2	Simplex Electrical Co., Boston, Mass	425.00	1,584.00	27,006.00
3	Bishop Gutta-Percha Co., New York, N. Y	422.00	1,925.38	29,988.42
4	Western Electric Co., New York, N. Y	649.44	2,581.92	42,720.48

The contract was awarded to the Safety Insulated Wire and Cable Company.

2. *For furnishing 26 rotary transformers, complete, with all accessories, opened September 7, 1897, by Maj. John G. D. Knight, Corps of Engineers, U. S. A., at Willets Point, N. Y.*

No.	Name and address of bidder.	Price for one.	Total of bid.
1	Wagner Electric Manufacturing Co., St. Louis, Mo	$152.52	$3,965.52
2	Western Electric Co., New York, N. Y	200.00	5,200.00
3	Manhattan Supply Co., New York, N. Y	208.00	5,408.00

The contract was awarded to the Wagner Electric Manufacturing Company.

3. *For furnishing 26 oil engines, each 4 H. P., complete, with link belts and all accessories, opened September 7, 1897, by Maj. John G. D. Knight, Corps of Engineers, U. S. A., at Willets Point, N. Y.*

No.	Name and address of bidder.	Price for one.	Total of bid.
1	De La Vergne Refrigerating Machine Co., New York, N. Y.:		
	On order for 12	$696.00	$17,316.00 for 26.
	On order for 20	666.00	
	On order for 30	636.00	
2	Shone Company, Chicago, Ill.:		
	On order for 12	425.00	10,400.00 for 26.
	On order for 20	410.00	
	On order for any number over 20	400.00	

The contract was awarded to the De La Vergne Refrigerating Machine Company.

4. *For furnishing 26 electric storage batteries, complete, with all accessories, opened September 7, 1897, by Maj. John G. D. Knight, Corps of Engineers, U. S. A., at Willets Point, N. Y.*

No.	Name and address of bidder.	Price for one.	Total of bid.
1	Western Electric Co., New York, N. Y	$284.00	$7,384.00
2	Electric Storage Battery Co., Philadelphia, Pa	284.00	7,384.00
3	Manhattan Supply Co., New York, N. Y	291.00	7,566.00

The contract was awarded to the Electric Storage Battery Company.

5. *For furnishing 28 switch boards (power boards), complete, with all accessories, opened November 26, 1897, by Maj. John G. D. Knight, Corps of Engineers, U. S. A., at Willets Point, N. Y.*

No.	Name and address of bidder.	Price for one.	Total of bid.
1	Foote, Pierson & Co., New York, N. Y	$368.00	$10,304.00
2	Wagner Electric Manufacturing Co., St. Louis, Mo	325.55	9,115.40
3	General Incandescent Arc Light Co., New York, N. Y	353.93	9,910.00
4	Western Electric Co., New York, N. Y	245.28	6,867.84
5	Frederick Pearce, New York, N. Y.:		
	Birch wood	264.29	7,400.00
	Oak wood	267.86	7,500.00
	Cherry wood	271.43	7,600.00

The contract was awarded to the Western Electric Company.

6. *For furnishing 46 operating boxes, complete, with all accessories, opened January 31, 1898, by Maj. John G. D. Knight, Corps of Engineers, U. S. A., at Willets Point, N. Y.*

No.	Name and address of bidder.	Price for one.	Total of bid.
1	Wagner Electric Manufacturing Co., St. Louis, Mo	$63.00	$2,898.00
2	Foote, Pierson & Co., New York, N. Y	28.20	1,297.20
3	Frederick Pearce, New York, N. Y	38.50	1,771.00
4	Ward Electric Supply and Construction Co., New York, N. Y	57.00	2,622.00
5	Western Electric Co., New York, N. Y	47.50	2,185.00

The contract was awarded to Messrs. Foote, Pierson & Co.

APPENDIX No. 3.

LETTER OF BRIG. GEN. GEORGE L. GILLESPIE, UNITED STATES VOLUNTEERS, COLONEL, CORPS OF ENGINEERS, COMMANDING DEPARTMENT OF THE EAST, UPON THE SUBJECT OF FORTRESS COMMANDER.

HEADQUARTERS DEPARTMENT OF THE EAST,
Governors Island, New York City, August 2, 1898.

GENERAL: I have had under consideration the subject of fortress commander, which you presented to me some days ago, but I do not know that I have much to add to the information now in your possession.

The natural chain of command for every division of the territory to be defended, including the coast line, is (1) general commanding military division; (2) fortress commander; (3) district commander; (4) fire commander.

Each military division may, and usually will, comprise several harbors, each of which will require fortress, district, and fire commanders. We are not concerned now with the division commander further than to state that every officer, soldier, and instrument of war, serving or employed in his division, shall be under his orders and control.

He may be of any arm of the service entitled to command, and his staff should be represented by at least one able officer taken from the engineers, ordnance, artillery, infantry, and signal corps, respectively.

FORTRESS COMMANDER.

It is impossible to define, in exact terms, the limits of a fortress commander's duty, which are determined by the special conditions of each locality. In general, he should control the fire of all the guns, wherever placed, which cover the land and water areas within the field of his command as well as all artificial obstructions placed in the channels. He should also command all the troops of every description comprising the defense of his harbor. The guns may be contained in a series of detached batteries in the same vicinity, or they may be in detached batteries located on opposite banks of a water course, and connected, in a military sense, by telegraphic, telephonic, or signal systems.

To understand the meaning of range of guns, as generally used in this connection, the object of the fire must be known. If effective penetration of thick armor be meant, it does not exceed 2 miles for the largest calibers; if penetration of deck, the distance may be extended to 10,000 yards, and over; if bombardment, it may reach 14,000 yards. Generally speaking, it will not exceed 10,000 yards.

The fortress commander should be an officer of artillery whose rank is proportionate to the importance of his command, and he should have

an adequate staff, including officers of engineers, ordnance, artillery, and signal corps. At each fortified locality there should be officers of artillery and engineers to perfect and carry out the plans for fire and mine control, chief of whom is the district commander, an officer of artillery, who arranges the method of fire control and transmits the necessary orders to the fire commanders, who in turn transmit orders for fire direction to battery commanders, and so on, to the lowest unit of command.

The Garrison Artillery Drill of the English service, an adopted guide in this matter, and the Drill Regulations for Coast Defense, United States, define in great detail how the fire is controlled, directed, and executed.

What you desire, I understand, is my opinion relative to the division and distribution of command in the defense of such a harbor as New York.

This harbor is so situated as to illustrate in an excellent way many, if not all, the problems of command usually arising, owing to its two entrances and the distinctive features which each possesses.

The harbor has two approaches—the southern, by way of Sandy Hook, and the eastern, by way of Long Island Sound.

The fortress commander should have his station at a convenient and central point in New York City, or at the principal fort on the southern entrance, should that be the main line of attack by the enemy.

SOUTHERN ENTRANCE.

1. *Narrows.*—At the Narrows, which is on the main line of modern defense at the southern entrance, we have an arm of the sea 5 miles long and 1 mile wide, defended by batteries on either shore, with provision for mine defense. The water area for the enemy's development, with a frontage of three battle ships, extends for over 3 miles seaward of the fortified line, and the shore batteries are so located that they can not be enfiladed or reached by reverse fire except when the line is forced and the enemy takes up positions in the inner harbor. As the high-power guns on the defensive line will eventually represent every adopted caliber, including the rapid-fire types, every gun of the locality should be controlled by a single mind, that the full power of the position may be judiciously used. I am therefore of the opinion that the fire of the Narrows should be controlled by a single commander, called the district commander, stationed at Fort Wadsworth, or one of its dependencies, the officer next in rank being stationed at Fort Hamilton, who, as fire commander of that fort, shall be in close connection with his senior and be kept fully informed of all his plans, so that in case of accident he may assume the superior command with confidence and efficiency. The officer second in rank at Fort Wadsworth will be the fire commander for that locality.

2. *Sandy Hook.*—Sandy Hook is a long and narrow sand spit extending into the ocean from the New Jersey shore, affording a wide envelopment of the enemy at a distance of 3½ miles and a corresponding long line of defense not easily enfiladed from the sea.

The bar at the main entrance in Gedneys Channel is 3 miles from the line of defense, and the available area for ship development inside the bar will be limited to two battle ships in line, with a few lighter-draft ships ranged on the shoals. * * * The main channel from the bar through the Lower Bay toward the city passes close under the guns at the Hook. The true object of the defenses on this advanced point is

to prohibit the use of the deep and quiet waters of Sandy Hook Bay by the enemy for purposes of anchorage, supply, or equipment.

As Sandy Hook is 10 miles distant from the Narrows and beyond the supporting distance of its batteries, its series of batteries should have a separate district commander, subordinate to the one at the Narrows. The defenses will be guided by the same principles outlined for the Narrows—the officer second in command, while directing the fire under the command of the district commander, will be given full information regarding the plans for the defense of the locality. Large discretion must be given to the district commander at the Hook in his defense after the first stages of the action.

EASTERN ENTRANCE.

1. Fort Schuyler–Fort Totten.—The water area to be defended on this line is a wide estuary, extending from Throgs Neck 5 to 6 miles eastward to the western entrance to Long Island Sound at Sands Point.

The main defenses are located at the gorge at Fort Schuyler, with advanced posts at Fort Slocum, Sands Point, and Hewletts Point.

The water in the channel everywhere is deeper than the probable requirements of any battle ship, but the area for ship development is circumscribed. The enemy will probably attempt to force the passage of the outer positions and take up a development only in front of Fort Schuyler.

The Fort Schulyer–Fort Totten line on the approach from Long Island Sound corresponds to the Narrows on the southern entrance. It should have its fire controlled by a single district commander at Fort Totten, assisted by an able officer second in command, stationed at Fort Schuyler, competent to exercise superior command in case of necessity.

2. Fort Slocum.—This fort, supported by the distant fire from the Schuyler–Totten line, distant 5 miles, will delay the enemy's operations at the western end of the Sound and prevent his taking up an anchorage from which to bombard the city. In this latter work it will be greatly assisted by the mortar batteries proposed to be erected upon Sands Point and Hewletts Point, whose rapid-fire armaments will also sweep the approaches and make their use difficult by swift cruisers or torpedo boats. It should have a fire commander, subordinate to the district commander at Fort Totten, to whom large discretion will be given after attack has begun.

Each of the isolated batteries at Sands Point and Hewletts Point should have a separate fire commander under the orders of the district commander at Fort Totten, with whom they should have protected telegraphic connection.

In conclusion: The plan here outlined contemplates for New York Harbor one fortress commander stationed at a central point, who shall have entire control of the defense of the harbor along both entrances, subject to the general commanding the land forces of the military division. There will be three district commanders—one at Fort Hancock, one at Fort Wadsworth, and one at Fort Totten. The fire commander at the several posts will transmit the orders of the district commander for fire direction to the several batteries under his charge, and will be held responsible that they are properly executed.

During the period of active operations of defense, when a unified command is imperative, engineer officers on duty in the harbor will be subject to the orders of the fortress commander in all that relates to

general measures of defense, and more immediately to the orders of the district commanders for placing and maintaining the mines or other artificial obstructions, for necessary repairs to fortifications, and for any engineer service which the emergencies of defense may require.

Floating batteries, designed to operate on or within the main line of defense, should naturally be controlled by the fortress commander; but, since they are placed under the commander of the Navy by our present system of separate command on land and water, no reference is made to them.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Colonel, Corps of Engineers, U. S. A.,
Brigadier-General, U. S. Volunteers,
Commanding Department of the East.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

APPENDIX No. 4.

FORTIFICATIONS.

FISCAL YEAR 1897-98.

4 A.

COASTS OF MAINE AND NEW HAMPSHIRE.

Officer in charge, Maj. Richard L. Hoxie, Corps of Engineers; assistant, Lieut. George P. Howell, Corps of Engineers; Division Engineer, Brig. Gen. George L. Gillespie, U. S. Volunteers, Colonel, Corps of Engineers.

PENOBSCOT RIVER, MAINE.

The condition of the old work and its armament is unchanged since the date of the Annual Report of 1896.

A project for the defense of Penobscot River, submitted by The Board of Engineers June 16, 1897, and approved by the Secretary of War June 25, 1897, proposes changes in the position of certain of the platforms for old-style armament and the addition of modern guns. No estimate of the cost has been made.

Minor repairs of the old work have been made during the last fiscal year, but appropriations for this purpose are inadequate. The principal work done has been a partial cleaning of the old armament during the latter part of the fiscal year 1898. The fort was occupied by troops during a portion of the fiscal year.

Money statement.

July 1, 1897, balance unexpended	$501.36
Allotted since	150.00
	651.36
June 30, 1898, amount expended during fiscal year	21.74
July 1, 1898, balance unexpended	629.62
July 1, 1898, outstanding liabilities	105.53
July 1, 1898, balance available	524.09

KENNEBEC RIVER, MAINE.

A project for the artillery defense of Kennebec River, Maine, submitted by The Board of Engineers May 21, 1897, and approved by the Secretary of War July 15, 1897, proposes for that purpose a modern armament, to be located at the site of the existing work, which is to be modified to meet modern requirements as to cover. No estimate of cost has been made.

No work under the existing project has been authorized. During the fiscal year just ended temporary wooden platforms for 15-inch guns have been constructed, and the carriages and guns mounted. A concrete emplacement to accommodate one 8-inch B. L. rifle on a strengthened barbette carriage for 15-inch smoothbore gun was in process of construction on the flank of the temporary platforms referred to. At the close of the fiscal year the platform and breast-height wall had been completed, the carriage mounted, and the magazine nearly finished. The greater part of the funds for the work was allotted from appropriation for "National Defense."

This post has been garrisoned during the latter part of the fiscal year.

Money statement.

July 1, 1897, balance unexpended	$210.25
Allotted since	1,630.00
	1,840.25
June 30, 1898, amount expended during fiscal year	1,746.91
July 1, 1898, balance unexpended	93.34
July 1, 1898, outstanding liabilities	45.00
July 1, 1898, balance available	48.34

By letter dated April 27, 1898, the Chief of Engineers directed the preparation of an emplacement for one 8-inch B. L. R. gun on strengthened barbette carriage for 15-inch smoothbore gun, and made a provisional allotment of $3,000 from appropriation for "National Defense," act of March 9, 1898.

June 8, 1898, an allotment of $4,400 was made from the same appropriation to complete temporary platforms for 15-inch guns, the cost of which had been partly provided for by an allotment from appropriation "Preservation and Repair of Fortifications."

By the close of the fiscal year, the platforms for the 15-inch guns had been completed, about one-eighth of the sand parapet was in place, and the guns and carriages were mounted. The platform and breast-height wall for the 8-inch B. L. R. gun were completed and carriage mounted waiting for the gun. The magazine was nearly finished. The 15-inch platforms are of wood.

Money statement.

Amount allotted April 27 and June 8, 1898	$7,400.00
June 30, 1898, amount expended during fiscal year	1,151.71
July 1, 1898, balance unexpended	6,248.29
July 1, 1898, outstanding liabilities	4,297.13
July 1, 1898, balance available	1,951.16

FORT GORGES, MAINE.

The condition of this old work and its armament is unchanged since the date of the Annual Report of 1896.

A storehouse estimated to cost $4,500, for the storage of torpedo material, was in progress of construction during the year, and with the exception of the concrete floor is practically completed. Minor repairs of the old work have been made during the last fiscal year, the chief item being the raking out and refilling of the joints of the lower courses of the scarp walls, near mean low tide, from which the mortar had been washed by the sea to a depth varying from 6 inches to 2 feet or more.

Money statements.

TORPEDOES FOR HARBOR DEFENSE.

Allotment of October 30, 1897	$4,500.00
June 30, 1898, amount expended during fiscal year	3,270.68
July 1, 1898, balance unexpended	1,229.32
July 1, 1898, outstanding liabilities	100.00
July 1, 1898, balance available	1,129.32

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1897, balance unexpended	$368.60
Allotted since	50.00
	418.60
June 30, 1898, amount expended during fiscal year	71.00
July 1, 1898, balance unexpended	347.60

FORT PREBLE, MAINE.

The existing project for the artillery defense of Portland Harbor contemplates the use of the old work and its armament, and since November 30, 1896, work has been in progress on the construction of a battery for sixteen 12-inch mortars. During nearly the entire time since commencement work has been carried on by double shifts, giving sixteen hours' work daily with as large a force as can be employed to advantage. At the close of the fiscal year practically all the excavation was completed, all the platforms were completed, all the base rings set, and one racer was in position. The concrete work of one of the magazines was nearly completed. About 6,662 cubic yards of concrete had been put in place up to that date. The details of quantities of work were given in the Annual Report for 1897.

The construction of a cable tank for storage of submarine cable in connection with mining defense was commenced early during the fiscal year, and the tank and shed covering have been entirely completed, except the painting of the latter. This tank is 47 feet by 26 feet, and has a capacity of thirty-six drums, the actual cost of the tank being $2,206.53 to the present time.

Under the head of "Preservation and Repair," a small amount of work was done during the year, the principal item being a new roof on the engineer storehouse.

One 15-inch S. B. platform was changed from high traverse to low, and at the end of the fiscal year work was in progress upon two more.

Money statements.

GUN AND MORTAR BATTERIES.

July 1, 1897, balance unexpended		$92,906.05
Allotted since		67,000.00
		159,906.05
June 30, 1898, amount expended during fiscal year		102,205.29
July 1, 1898, balance unexpended		57,700.76
July 1, 1898, outstanding liabilities	$7,392.40	
July 1, 1898, amount covered by uncompleted contracts	15,432.40	
		22,824.80
July 1, 1898, balance available		34,875.96

TORPEDOES FOR HARBOR DEFENSE.

July 1, 1897, balance unexpended	$3,200.00
June 30, 1898, amount expended during fiscal year	2,206.53
July 1, 1898, balance unexpended	993.47
July 1, 1898, outstanding liabilities	50.00
July 1, 1898, balance available	943.47

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1897, balance unexpended	$1,554.47
June 30, 1898, amount expended during fiscal year	255.29
July 1, 1898, balance unexpended	1,299.18
July 1, 1898, outstanding liabilities	100.00
July 1, 1898, balance available	1,199.18

Abstract of proposals for cement, opened March 31, 1898.

No.	Bidder.	6,000 barrels Portland cement. Price per 100 pounds.	3,000 barrels natural cement. Price per 100 pounds.	Amount.
1	New York and Rosendale Cement Co., New York, N. Y.		80 cents per barrel, of 300 pounds.	$2,400.00
2	Standard Silica Cement Co., New York, N. Y.	52⅞ cents		11,835.00
3	Frank H. Sloan, Baltimore, Md.	53¼ cents		12,037.20
4a	The Kelley Island Lime and Transport Co., Cleveland, Ohio.	61 cents		13,725.00
5	Manhattan Cement Co., New York, N. Y.	$2.30 per barrel, of 375 pounds.		13,800.00
6	Atlas Cement Co., New York, N. Y.	56 cents		12,600.00
7	Charles W. Hall, New York, N. Y.	64.4 cents		14,490.00
8	Lawrenceville Cement Co., New York, N. Y.		93 cents per barrel, of 300 pounds.	2,790.00

a Price raised to 65 cents in a subsequent letter.

List of contracts, fiscal year 1898.

Name of contractor: W. G. Nash (closed).
Date of contract: August 29, 1896.
Date of approval: September 16, 1896.
Time for commencement: On 30 days' notice.
Time for completion: As may be required.
Price for Portland cement: $2.05 per barrel.
Price for natural cement: 85 cents per barrel.

Name of contractor: Frank W. Mason.
Date of contract: August 26, 1896.
Date of approval: September 1, 1896.
Time for commencement: On notice of 10 days.
Time for completion: As required by the engineer.
Price for sand: 94 cents per cubic yard.

Name of contractor: Atlas Cement Company.
Date of contract: April 26, 1898.
Date of approval: May 14, 1898.
Time for commencement: Within 20 days of date of order.
Time for completion: June 30, 1898.
Price for Portland cement: 56 cents per 100 pounds.

Name of contractor: New York and Rosendale Cement Company.
Date of contract: April 20, 1898.
Date of approval: April 29, 1898.
Time for commencement: Within 20 days of date of order.
Time for completion: June 30, 1898.
Price for natural cement, 26¾ cents per 100 pounds.

FORT SCAMMEL, MAINE.

Minor repairs of the old work, including doors of magazines, embrasure shutters, etc., have been made during the last fiscal year. The appropriations for this purpose are inadequate.

Two 15-inch smoothbore guns and carriages were mounted during the latter part of the fiscal year.

Money statement.

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1897, balance unexpended	$517.34
Allotted since	550.00
	1,067.34
June 30, 1898, amount expended during fiscal year	315.64
July 1, 1898, balance unexpended	751.70
July 1, 1898, outstanding liabilities	150.00
July 1, 1898, balance available	601.70

FORT McCLARY, MAINE.

The condition of this old work is unchanged since the date of the Annual Report for 1896. The only work of importance carried on during the year consisted in mounting three 15-inch guns on temporary wooden platforms during the latter part of the fiscal year.

Money statement.

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1897, balance unexpended	$111.96
Allotted since	2,400.00
	2,511.96
June 30, 1898, amount expended during fiscal year	1,452.78
July 1, 1898, balance unexpended	1,059.18
July 1, 1898, outstanding liabilities	515.63
July 1, 1898, balance available	543.55

PORTLAND HEAD, MAINE.

On Battery B work was commenced in April, 1893, and is completed, except a portion of the ironwork, trolleys, etc., yet to go in place. Both guns are mounted. On Battery C work was commenced in October, 1894, and is completed, with the exception of a portion of the ironwork yet to be put in place. All the guns are mounted. An emplacement for a 6 inch rapid-fire gun has been in process of construction under an allotment from appropriation for "National Defense," for which a separate report is submitted. The total expenditures on Batteries B and C have been $213,910.59. The total estimated cost of the work is $224,000.

Money statement.

GUN AND MORTAR BATTERIES.

July 1, 1897, balance unexpended	$39,617.68
Allotted since	21,000.00
	60,617.68
June 30, 1898, amount expended during fiscal year	50,528.27
July 1, 1898, balance unexpended	10,089.41
July 1, 1898, outstanding liabilities	533.24
July 1, 1898, balance available	9,556.17

List of contracts in force during fiscal year 1898.

Name of contractor: Coolidge & Wait.
Date of contract: August 26, 1896.
Date of approval: September 17, 1896.
Time for commencement: On award of contract.
Time for completion: As may be required.
Price per barrel for Portland cement: $2.22.

Name of contractor: W. C. Nash.
Date of contract: August 29, 1896.
Date of approval: September 16, 1896..
Time for commencement: On thirty days' notice.
Time for completion: As may be required.
Price per barrel for natural cement: 98 cents.

Name of contractor: George C. Place.
Date of contract: August 26, 1896.
Date of approval: September 16, 1896.
Time for commencement: On award of contract.
Time for completion: As required by engineer.
Price per cubic yard for sand: $1.20.

By letter dated April 25, 1898, the Chief of Engineers directed the construction of one emplacement for a 6-inch rapid-fire gun, and made a provisional allotment of $8,000 from appropriation for "National Defense." The work was commenced during May, 1898, and by the close of the fiscal year the excavation had been completed and 225 cubic yards of concrete had been put in place, completing the platform, which is waiting for the gun.

Money statement.

Amount allotted April 25, 1898	$8,000.00
June 30, 1898, amount expended during fiscal year	91.98
July 1, 1898, balance unexpended	7,908.02
July 1, 1898, outstanding liabilities	1,860.66
July 1, 1898, balance available	6,047.36

GREAT DIAMOND ISLAND, MAINE.

Under the fortification act approved May 7, 1898, work has been authorized upon emplacements for two 12-inch B. L. rifles and two 8-inch B. L. rifles, and plans and estimates have been directed to be submitted for a battery mounting eight 12-inch mortars. Work on emplacements for six 8-inch guns and on temporary platforms for two 8-inch converted rifles has been in progress under an allotment from appropriation for "National Defense," of which a separate report is submitted. Work on the two 12-inch emplacements has been in progress since early in April,

1897, under a contract with William Morgan, of Trenton, N. J. At the close of the fiscal year the excavation was nearly finished; about 2,908 cubic yards of concrete had been put in place and the anchor bolts for one platform set. An artesian well had been completed, a pumping plant established and housed, a substantial stone wharf and roadway leading thereto had been completed. The progress made under the contract for these emplacements has not been satisfactory, and on July 7, 1898, the contract was annulled. The work will be finished by day-labor and the purchase of material in open market.

Money statement.

GUN AND MORTAR BATTERIES.

July 1, 1897, balance unexpended		$72,512.38
June 30, 1898, amount expended during fiscal year		27,676.29
July 1, 1898, balance unexpended		44,836.09
July 1, 1898, outstanding liabilities	$7,832.83	
July 1, 1898, amount covered by uncompleted contracts	35,760.66	
		43,593.49
July 1, 1898, balance available		1,242.60

List of contracts in force during fiscal year 1898.

Name of contractor: William Morgan.*
Date of contract: March 2, 1897.
Date of approval: March 16, 1897.
Time for commencement: April 1, 1897.
Time for completion: June 30, 1898.

Name of contractor: T. W. Kinser & Sons.*
Date of contract: March 6, 1897.
Date of approval: March 24, 1897.
Time for commencement: April 1, 1897.
Time for completion: May 1, 1898.

March 18, 1898, the construction of six emplacements for 8-inch guns on disappearing carriages was directed by the Chief of Engineers, an allotment of $150,000 being made at the same time from the emergency appropriation for "National Defense," act of March 9, 1898. Detailed estimates of cost for this work have not yet been completed.

There was allotted June 28, 1898, from the same appropriation the sum of $3,000 to provide temporary platforms to mount two 8-inch converted rifles to cover the mine field.

March 21, 1898, work was commenced at the site of the batteries for 8-inch disappearing guns, with 19 men, which had been increased at the close of the fiscal year to a force of over 400, and work was carried on by double shifts, giving sixteen hours' continuous work each day. New plant has been purchased and established, including stone crushers, hoisting engines, concrete mixers, temporary buildings providing ample storage for cement, carpenter shop, blacksmith shop, etc., and a substantial pile wharf, with wooden deck 41 feet by 45 feet, with a depth of 8 feet at mean low tide at its face, has been constructed; an artesian well has been sunk to a depth of 216½ feet, from which there flows a supply of good water, to be increased by pumping. In addition to the plant obtained by purchase, practically all the old plant which was

* For details and prices of work under the contract see abstract of bids submitted with Annual Report for fiscal year 1897. Contract with T. W. Kinser & Sons completed.

used in the construction of batteries at Portland Head has been transferred to this work. At the close of the fiscal year about 9,535 cubic yards of rock and 2,885 cubic yards of earth had been excavated, nearly completing the excavation of Battery A. A supply of cement and sand had been brought to the site and preparation of false work preliminary to putting in concrete had been commenced. Contracts have been made for the cement to be used for the construction of these emplacements.

The temporary platforms for the 8-inch converted rifles, with magazine, have been completed and the guns are mounted.

Money statements.

FOR EMPLACEMENTS FOR 8-INCH B. L. R. GUNS.

Amount allotted March 18, 1898		$150,000.00
June 30, 1898, amount expended during fiscal year		22,928.80
July 1, 1898, balance unexpended		127,071.20
July 1, 1898, outstanding liabilities	$29,435.33	
July 1, 1898, amount covered by uncompleted contracts	43,350.00	
		72,785.33
July 1, 1898, balance available		54,285.87

EXPENDITURES.

Battery A	$14,730.88
Battery B	6,037.30
Battery D	2,160.62

FOR TWO 8-INCH CONVERTED RIFLES.

Amount alloted June 28, 1898	$3,000.00
July 1, 1898, balance unexpended	3,000.00
July 1, 1898, outstanding liabilities	1,845.61
July 1, 1898, balance available	1,154.39

Abstract of proposals for furnishing cement March 31, 1898.

No.	Bidders.	15,000 barrels Portland cement, price.	15,000 barrels natural cement, price.	Amount
1	New York and Rosendale Cement Co., New York, N. Y.	.....	80 cents per barrel, of 300 pounds.	$13,000.00
2	Standard Silica Cement Co., New York, N. Y.	47¾ cents per 100 pounds.	.....	26,662.50
3	Atlas Cement Co., New York, N. Y.	$2.09 per barrel, of 375 pounds.	.....	31,350.00
4	Frank H. Sloan, Baltimore, Md	53½ cents per 100 pounds.	.....	30,093.75
5	Lawrenceville Cement Co., New York, N. Y.	.....	93 cents per barrel, of 300 pounds.	13,950.00

List of contracts in force during the fiscal year 1898.

Name of contractor: Atlas Cement Company.
Date of contract: April 18, 1898.
Date of approval: April 24, 1898.
Time for commencement: April 15, 1898.
Time for completion: November 1, 1898.
Price for Portland cement: $2.09 per barrel of 375 pounds.

Name of contractor: New York and Rosendale Cement Company.
Date of contract: April 19, 1898.
Date of approval: April 29, 1898.
Time for commencement: April 15, 1898.
Time for completion: November 30, 1898.
Price for natural cement: 26¾ cents per 100 pounds.

BAR HARBOR, ME.

The project for temporary defense of Bar Harbor provides for two 8-inch converted rifles and two 10-inch S. B. guns, all mounted on temporary wooden platforms. The work was ordered in April, 1898, and on June 23, 1898, an allotment of $6,000 was made from appropriation for "National Defense." The consent of the owners of the sites was secured, the materials were purchased and shipped, and the guns and carriages were delivered at Bar Harbor during the month of May, 1898.

Money statement.

Amount allotted June 23, 1898	$6,000.00
July 1, 1898, balance unexpended	6,000.00
July 1, 1898, outstanding liabilities	2,164.00
July 1, 1898, balance available	3,836.00

PORTSMOUTH HARBOR, NEW HAMPSHIRE.

A contract for the construction of the emplacements for the 8-inch guns was entered into December 30, 1896; work was commenced on the 14th of April, 1897, and has been in operation continuously since, except a short period during the winter months. The work is now nearly completed, and guns are mounted.

Minor repairs have been made to the buildings, etc., under a small allotment from appropriation "Preservation and Repair of Fortifications."

This post has been garrisoned during a part of the fiscal year 1898.

Money statements.

GUN AND MORTAR BATTERIES.

July 1, 1897, balance unexpended		$52,688.80
June 30, 1898, amount expended during fiscal year		26,794.55
July 1, 1898, balance unexpended		25,894.25
July 1, 1898, outstanding liabilities	$3,155.40	
July 1, 1898, amount covered by uncompleted contracts	22,682.04	
		25,837.44
July 1, 1898, balance available		56.81

TORPEDOES FOR HARBOR DEFENSE.

July 1, 1897, balance unexpended	$1,000.00
July 1, 1898, amount covered by uncompleted contracts	500.00
July 1,1898, balance available	500.00

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1897, balance unexpended	$323.00
Allotted since	800.00
	1,123.00
June 30, 1898, amount expended during fiscal year	124.50
July 1, 1898, balance unexpended	998.50
July 1, 1898, outstanding liabilities	10.00
July 1, 1898, balance available	988.50

List of contracts in force during fiscal year 1898.

Name of contractor: The Hartford Paving and Construction Company.
Date of contract: December 30, 1896.
Date of approval: February 1, 1897.
Time for commencement: April 15, 1897.
Time for completion: July 31, 1898.
For details and prices see abstract of bids submitted with Annual Report for fiscal year ending June 30, 1897.

By letter dated April 27, 1898, the Chief of Engineers directed the preparation of emplacements for two 8-inch B. L. R. guns mounted on strengthened barbette carriages for 15-inch smooth-bore guns, and made a provisional allotment of $6,000 from appropriation "National Defense." It was decided to locate these guns on the outer line of defense, there being already at this place platforms for 15-inch S. B. guns of the latest approved type. The carriages were received during the month of June, 1898, have been mounted and are waiting for the guns, but have not yet been strengthened to receive them. The guns will be mounted when received, and suitable disposition will be made for the service of ammunition.

Money statement.

Amount allotted April 27, 1898	$6,000.00
July 1, 1898, balance unexpended	6,000.00

TORPEDOES FOR HARBOR DEFENSE.

The project for torpedo defense on the coasts of Maine and New Hampshire includes Penobscot and Kennebec rivers, and Portland Harbor, Maine, and Portsmouth Harbor, New Hampshire. Allotments for this purpose aggregating $23,300 have been made from appropriation for "National Defense" since the passage of the act of March 9, 1898. During April, 1898, mines were placed in three channels leading into Portland Harbor.

Early in May mines were placed in Portsmouth Harbor, and in the Kennebec and Penobscot rivers. The operations included collection of large quantities of material, hire of tug boats, lighters, and a force of boatmen. The active force engaged on this work included also an engineer detachment of 10 men from Willets Point, N. Y. Patrol boats have also been maintained in Portland Harbor, Kennebec River, and Penobscot River, Maine. Besides this, six mining casemates have been equipped, and electricians stationed at each.

Money statement.

Amounts allotted	$23,300.00
June 30, 1898, amount expended during fiscal year	7,593.02
July 1, 1898, balance unexpended	15,706.98
July 1, 1898, outstanding liabilities	13,558.54
July 1, 1898, balance available	2,148.44

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4 B.

BOSTON HARBOR, MASSACHUSETTS.

Officer in charge, Col. Samuel M. Mansfield, Corps of Engineers; assistant, Maj. John Stephen Sewell, U. S. Volunteers, Lieutenant, Corps of Engineers.

Emplacements for five 10-inch guns, disappearing carriages, and for two 4-inch rapid-fire guns.—The present approved project covers the build-

ing of three emplacements for 10-inch guns. In addition, the building of two emplacements for 10-inch guns and two emplacements for rapid-fire guns was authorized under the appropriation for "National Defense," act of March 9, 1898.

At the beginning of the year there remained, to complete the three 10-inch emplacements, the installation of an electric-light plant, and the providing of ammunition service, magazine doors, railing, and ladders.

During the year the electric-light plant was installed, the ammunition service nearly completed, materials for magazine doors and for railing advertised for, and the ladders ordered.

Three 10-inch disappearing guns and carriages were mounted.

The following platforms are now ready for their armament: Five modern 10-inch rifles, disappearing carriages (two constructed under appropriation for "National Defense," act of March 9, 1898); two modern 4-inch rapid-fire guns and mounts (Driggs-Schroeder).

Money statement.

July 1, 1897, balance available	$14,296.70
Expended during fiscal year	9,619.87
July 1, 1898, balance available	4,676.83

By letters of March 18, 1898, and April 23, 1898, allotments amounting to $74,000 were made by the Chief of Engineers from the appropriation for "National Defense," act of March 9, 1898, for the construction of two 10-inch gun emplacements, and by letters of May 3, 1898, and June 7, 1898, allotments amounting to $9,090 were made by the Chief of Engineers, from the same appropriation, for the construction of two emplacements for rapid-fire guns.

A project and estimate for the former was submitted to the Chief of Engineers by letter dated April 21, 1898, and for the latter by letter dated June 3, 1898.

Work was begun on the two 10-inch gun emplacements on March 28, 1898, and on the two emplacements for rapid-fire guns on May 17, 1898.

At the end of the fiscal year about three-fourths of all excavation and fill had been completed and the four platforms were ready for their mounts. The rapid-fire guns and mounts are on hand and will be placed in position as soon as possible.

Work is to be continued on these emplacements as rapidly as possible, and it is expected to have them completed by the end of September, 1898.

The amounts and dates of the appropriations for this work were as follows:

March 18, 1898	$50,000
April 23, 1898	24,000
May 3, 1898	6,000
June 7, 1898	3,090
	83,090

Money statement.

Allotted	$83,090.00
Expended during fiscal year	19,760.44
July 1, 1898, balance available	63,329.56

Emplacements for five 10-inch guns, disappearing carriages, and for two 4.7-inch rapid-fire guns.—At the beginning of the fiscal year the gun platforms of emplacements Nos. 1, 2, 3, and 4 and the parapets of emplacements Nos. 1, 2, and 3 were completed; the excavation for para-

pet walls and magazines for emplacement No. 4 was nearly ready for concreting, and the excavation for emplacement No. 5 was partly done.

The masonry construction for loading platforms had not then been begun.

One casemate for a rapid-fire gun was completed, with the exception of opening the port.

During the year about four-fifths of all excavation was completed. Parapet walls of emplacements Nos. 1, 2, and 3 were finished, that of emplacement No. 4 nearly so, and that of No. 5 about one-half done. The loading platform of No. 1 was completed; and of Nos. 2, 3, 4, and 5, all done except the granolithic finish.

Two emplacements for rapid fire guns, authorized to be constructed under the appropriation for "National Defense," act of March 9, 1898, are about one-half done.

Ammunition-service trolley beams were placed in position on emplacements 1, 2, and 3.

An electric-light plant of 25 kilowatts capacity was installed and service magazines were wired and lighted; a permanent structure for this plant has yet to be built.

A cable tank was constructed and is now completed, with the exception of some necessary painting and the installation of a traveler for handling drums, and a windmill or pump. A separate report is submitted for this work.

A new wharf was built on the site of the old one on the north side of the island. It extends into water of sufficient depth (12.5 feet at mean low water) to accommodate the craft delivering materials and supplies to the fort.

Five 10-inch guns on disappearing carriages and two 4.7-inch Elswick rapid-fire guns were mounted, the latter under the appropriation for "National Defense."

The following guns are on hand: Five 10-inch rifles, disappearing carriages, all mounted; two 4.7-inch Elswick rapid-fire guns, all mounted.

Money statement.

July 1, 1897, balance available	$178,528.20
Expended during fiscal year	88,520.86
July 1, 1898, balance available	90,007.34

On April 6 and 20, 1898, allotments aggregating $14,740 were made from the appropriation for "National Defense," act of March 9, 1898, to complete two emplacements for rapid-fire guns.

A project and estimate for this work was submitted to the Department on April 18, 1898.

Excavation was begun on April 16, 1898, and the mounting of the guns on their finished platforms was completed on May 16, 1898.

At the end of the fiscal year the excavation was practically finished, and about one-half of all concrete work was completed.

Work is to be continued on these emplacements as rapidly as possible, and it is expected to have them completed in August, 1898.

Money statement.

Allotted	$14,740.00
Expended during fiscal year	3,186.03
July 1, 1898, balance available	11,553.97

Mortar battery for sixteen 12-inch mortars.—The detailed plans of this battery were approved by the Chief of Engineers April 14, 1891.

Operations have been limited to the construction of the southwest battery, and funds were provided to build it and to mount the mortars.

On June 30, 1897, this battery had been completed and had been turned over to the commanding officer, Fort Warren, Mass., for use and care by the troops on July 25, 1896, in accordance with provisions of Army Regulations, 1486, under authority of the Acting Secretary of War, dated June 29, 1896.

It is now in the charge of an artillery garrison.

In October, 1897, the balance of funds on hand was transferred to the mortar battery for eight 12-inch mortars and the work dropped by authority of the Department.

On April 6, 1898, an allotment of $275 was made from appropriation for "Preservation and Repair of Fortifications," for repair of the electric-light plant.

The necessary repairs were made during the month of April, 1898.

Money statement.

REPAIRS TO ELECTRIC PLANT.

Allotted during fiscal year	$275.00
Expended during fiscal year	105.04
July 1, 1898, balance available	169.96

On June 14, 1898, $500 was allotted from the appropriation for "Gun and Mortar Batteries," for the purpose of easing the slopes around the mortar carriages.

Operations were commenced in June, and at the date of this report the alterations are in progress.

Money statement.

July 1, 1898, balance available	$500.00

Three emplacements for 12-inch rifles, disappearing carriages.—This work was authorized on March 18, 1898, and funds allotted therefor from the appropriation for "National Defense," act of March 9, 1898. A preliminary project and estimate was submitted on April 18, 1898.

Construction work was commenced in April, 1898, and at the date of this report the three gun platforms are completed ready for mounting of guns and carriages. Excavation for the site and rammed earth embankment have been completed in preparation for concrete construction of magazines and protective works, upon which nothing has been done.

Money statement.

Allotted	$151,680.00
Expended during fiscal year	11,888.04
July 1, 1898, balance available	139,791.96

Mortar battery for eight 12-inch mortars.—The Commonwealth of Massachusetts ceded jurisdiction over the site to the National Government by act approved April 6, 1897.

Plans prepared by The Board of Engineers, dated August 1, 1889, provided for a battery of sixteen 12-inch mortars at this site.

By Department letter of April 6, 1897, plans and estimates for the construction of emplacements for eight 12-inch mortars were called for.

These were prepared and submitted on July 17, 1897, and an allotment of $108,000 was made July 22, 1897, from appropriation for "Gun and Mortar Batteries," act of March 3, 1897.

The working drawings and specifications were finished when, in March, 1898, the purchase of the land was finally consummated.

On May 14, 1898, bids were opened. The award was made to Yates & Triest, of New York, the lowest bidders, and contract was entered into on June 9, 1898.

Excavation was begun on June 15, 1898.

At the end of the fiscal year the work of excavation was well under way, the erection of temporary buildings was in progress, and part of the wharf material had been received.

Money statement.

Allotted during fiscal year	$108,000.00
Expended during fiscal year	100.00
July 1, 1898, balance available	107,900.00

Two emplacements for 12-inch rifles, nondisappearing carriages.—Instructions were received under date of April 25, 1898, to construct two emplacements for 12-inch guns on barbette carriages with funds allotted from the appropriation for "National Defense," act of March 9, 1898.

A topographical survey of the site was immediately begun and preparations made of preliminary plans and estimates with a view to vigorous operations in the field at the earliest possible moment.

By the 1st of June the survey of the site was finished and plotted, and work had begun on the plans and carried so far as to permit a beginning of work of excavation on the site before the close of the month. Investigations were also nearly completed for supplies of necessary material for construction and means of delivery, which involved the construction of a spur railroad track in connection with the road of the New York, New Haven and Hartford Railroad Company, which skirts the foot of the bluff.

Money statement.

Allotted	$80,000.00
Expended during fiscal year	125.00
July 1, 1898, balance available	79,875.00

Range-finding communications.—The approved project was to establish communications for range-finding service.

An allotment was made on April 26, 1898, of $4,800 from the appropriation for "National Defense," act of March 9, 1898.

Money statement.

Allotted	$4,800.00
Expended during fiscal year	1,245.12
July 1, 1898, balance available	3,554.88

Storage for torpedo material.—Under instructions of the Chief of Engineers, dated August 14, 1896, detailed plans and estimated cost of a cable tank for use in submarine mine defense of Boston Harbor was submitted on January 11, 1897.

A site was selected for this structure, and provision was made for the wet storage of all cable necessary for the service, as planned by The Board of Engineers.

Under date of May 20, 1897, a report was submitted, with a list of personnel and material required to execute the approved project for the submarine-mine defense of Boston Harbor, with a recommendation that a base of operations be established, to which the torpedo material should be removed. This received the approval of the Chief of Engineers, by indorsement, May 27, 1898.

On January 13, 1897, an allotment of $4,300 was made for the construction of a cable tank, and on July 28, 1897, one of $1,035 was made for the removal of torpedo material to the place selected as a base of operations.

At the beginning of the fiscal year work on the cable tank had only just begun.

During the year the cable tank was finished, with the exception of the erection of a windmill or pump and the application of a final coat of paint to the shed. All torpedo material was removed and cleaned and stored.

Money statement.

July 1, 1897, balance available	$4,258.96
Allotted since	1,035.00
	5,293.96
Expended during fiscal year	3,289.71
July 1, 1898, balance available	2,004.25

Purchase of torpedo material.—On May 14, 1898, an allotment was made by the Chief of Engineers, from the appropriation for "Torpedoes for Harbor Defense, January 1, 1899," act of March 4, 1898, of $25,000, for the purchase of additional torpedo material, required for the general submarine mine defense of Boston Harbor, and to be applied to the purchase of cable.

All the cable was purchased during the fiscal year.

Money statement.

Allotted during fiscal year	$25,000.00
Expended during fiscal year	6,047.76
July 1, 1898, balance available	18,952.24

Planting mines (National Defense).—The approved project involves the use of 506 mines of all kinds, 17 miles of multiple cable, 54 miles of single conductor cable, the corresponding number of switch boxes, junction boxes, etc., and if full charge be allowed, to ground mines, and 150 pounds each to No. 43 mine cases, 62,000 pounds of dynamite. In addition it contemplates the purchase of explosives and the laying of 400 improvised mines in Broad Sound and Nahant Bay.

By the 1st of April, 5,500 pounds of 75 per cent dynamite had been ordered, and during the month of April 2,000 service fuses and 2,000 cut-offs and 40,000 pounds of 75 per cent dynamite were received and a project submitted for the use of improvised mines in Broad Sound and Nahant Bay.

All the necessary casemate instruments for Boston Harbor proper, 5 miles of multiple cable and 8 miles of single conductor cable, were supplied from the Engineer Depot; also 252 service fuses and 168 cut-offs. All the mine cases and anchors were on hand, also a small supply of lowering and mooring rope, and nearly all the shackles and junction boxes required.

A small supply of loading wire, fuse wire, rubber packing, rubber tubing, etc., was received from the Engineer Depot. No false seats

for the glands of the switch boxes were supplied, and the brass washers sent were too large.

All small supplies, such as washers, turks head collars, etc., needed for loading mines and switch boxes, were ordered in the open market, and received. Ten miles of multiple cable and 20 miles of single conductor cable were ordered, and most of it is delivered. One cable machine was discovered here, after a long search, which was not working for the Engineer Depot; otherwise no cable could have been obtained. While it still seemed improbable that any armored cable other than shipments promised by the engineer depot could be obtained, one-half mile of lead armored 7-core cable and 8 miles of lead armored single core cable were ordered and received. The latter will be utilized in Broad Sound. Some of it has been used for wiring the gun batteries, where a cable had to be buried.

All the firing, testing, and signal batteries supplied from the Engineer Depot were overhauled, cleaned, and put in good order.

The Leclanché cells needed cleaning very badly, and as there were altogether about 400 of them, including service detectors and testing batteries, this was quite a task. A large number had to be unsealed, zincs cleaned, and cells charged all over again.

The casemates were opened up, cleaned out, wired, equipped with benches and blowers for ventilation and drying out, and about two-thirds of their electrical equipment was put in.

About 42 switch boxes were loaded, 63 mines loaded in all respects, and about 100 compound plugs in addition were charged. About 125 circuit closers in addition to those in the mines and plugs above referred to were adjusted, and the fuses and loading wires attached. Fuses and loading wires were prepared for about 100 more.

Orders to plant the mines were received on April 23. At that time preparations were in progress for laying cable, a sufficient quantity to begin on having been received. A strong easterly gale began on that day and continued until the afternoon of April 30. The sea raised by this was so rough that it was physically impossible to plant the mines. Continued efforts were made, at the risk of the lives of the men, but all that could be accomplished was to lay 6 multiple cables, 2 of which could not be extended quite to the grand junction boxes.

During the month of May mines were assembled and planted in Boston Harbor proper, and multiple cables were run. All shore work except insertion of dynamite and assembling of mines was finished. The equipment of the casemates was practically completed.

With the exception of May 30, on which no work was done because of the holiday, and May 31, the last ten days of May were so rainy, rough, and foggy, that very little could be accomplished on the water, so that the mines represent, in reality, only about three weeks' work, and part of that time was consumed in getting the working parties into training. On the Nahant project nearly all the preliminary shore work, except loading and assembling the mines, was finished for half of the total number contemplated. Twenty-five thousand pounds of Forcite gelatine and 25,500 pounds of 75 per cent dynamite were received. Two of the improvised mines were loaded with the gelatine and exploded, for the purpose of determining whether the gelatine would surely detonate with a priming charge of 1 pound of dynamite, whether the spacing between mines to be exploded individually could be reduced, and whether the improvised circuit closers recovered from the shock of neighboring explosions with the desired degree of quickness.

There was no doubt of the perfect detonation of the gelatine. An empty barrel, such as that used for the mine cases, had its head knocked in at a distance of 100 feet, showing that the greater spacing adopted in the project was probably a minimum, and the recovery of the circuit closer was satisfactory.

In Boston Harbor proper much trouble was experienced with leaky switch boxes, notwithstanding the utmost care in loading.

In the majority of cases the triple boxes have been raised and the switch boxes taken out. This may slightly complicate the working of the mines in action, but it makes their operation certain until at least one mine of a triple group is exploded; and, with the leaky switch boxes, no certainty of action was assured at all. During the dense fogs which prevailed during the latter part of May, two or three sailing vessels blundered into the mine fields and dropped their anchors. One was discovered by the patrol boat and compelled to cut her anchor line and move out; but the daily tests indicate that the others have seriously damaged one grand group.

The indications of damages reported last month have proved to be due almost entirely to leaky switch boxes, but there seems no doubt that the sailing vessels referred to have really done some damage this time with their anchors. The fog was so thick it was impossible for any vessel to know clearly where she was, and equally impossible for the patrol boat to see all vessels.

By the first of June all material required for the execution of the entire project had been ordered and received.

During the greater part of June one steam lighter and two small tugs, with a force of linemen and boatmen, were engaged in overhauling and repairing the mines planted.

One mine proved to be leaky owing to an injury received while in store at Fort Warren, two have been sunk by the propellers of steamers, and one was set adrift by a schooner which anchored among the mines in a fog. One of the leaky mines was exploded. The two others will be destroyed as soon as possible.

Money statement.

Allotted	$68,700.00
Expended during fiscal year	30,838.50
July 1, 1898, balance available	37,861.50

Sites.—Under date of August 17, 1896, the officer in charge was requested to report the areas which he thought should be acquired as sites for works for the defense of Boston Harbor, to be located on land not now owned by the United States, as indicated in the approved project of The Board of Engineers dated August 1, 1889, the names of the owners, the area owned by each owner, the improvement thereon, if any; the lowest price at which each owner will probably sell; whether such prices are considered by him reasonable; and whether, in his opinion, the sites should be purchased by agreement with the owners, or should be acquired by condemnation.

Approximate estimates were telegraphed to the Department September 19, 1896, for use in Annual Report of the Chief of Engineers.

Peddocks Island.—On January 12, 1897, the officer in charge was directed, by authority of the Secretary of War, to purchase 33.13 acres of this island.

The deed to the United States for this property was acquired from the owner March 10, 1897, and submitted the same day to the United

States attorney for this district with request for examination of title and the preparation of such papers as would enable the Attorney-General to certify concerning the validity of title. The consideration in the deed is $28,000.

The tract was surveyed and the boundary suitably marked by stone posts.

On the 30th of June, 1897, no report has been received from the district attorney.

January 14, 1898, report upon title to this property was received from the district attorney and forwarded to the Department January 15.

Under date of February 3, 1898, the Attorney-General approved of the title, and upon the registry of the deed in the Plymouth County office of records the purchase was completed by payment to the owner of the consideration named in the deed, viz, $28,000 on March 3, 1898.

Deer Island.—On March 8, 1897, the Mayor of Boston presented to the Board of Aldermen of the city an order providing for the transfer by the city of Boston to the United States of three certain parcels of land on Deer Island as sites for harbor batteries or other defenses. This order was passed by the Board of Aldermen December 28, 1897, was concurred in by the Common Council December 30, 1897, and approved by the Mayor December 31, 1897. It transferred to the United States, for a nominal consideration, 23.34 acres of land on Deer Island.

The Department considering the area offered entirely inadequate for the accommodation of the batteries projected for Deer Island, the officer in charge was instructed, under date of May 20, 1898, to communicate with the Mayor of Boston relative to the acquisition by the United States of a much larger area, either by gift or purchase. Accordingly, the officer in charge addressed a communication to the Mayor, submitting therewith a blue print showing the boundaries of the area desired by the United States, and the latter's reply, saying the committee on public improvements of the Board of Aldermen do not feel justified in assenting to the voluntary transfer of the additional land on Deer Island desired, and hoping that the War Department will not press the matter further at this time, dated June 21, 1898, was submitted to the Department June 25, 1898.

Nantasket Head.—On April 2, 1897, the officer in charge furnished the Department with a tracing showing the boundary of the land which he thought it desirable for the United States to acquire in this locality, and recommended its purchase in open market after employing a competent real estate agent to fix upon values. His recommendation was approved.

The report of values fixed by the expert was submitted to the Department and the officer in charge was authorized June 12, 1897, to purchase the several parcels of land comprising the area of about 55 acres described, at the most reasonable prices attainable, not to exceed in any case the valuation as set forth in the report of the expert.

Negotiations have been actively carried on ever since for the acquisition of this property, and at the close of the present year—1898—there has been purchased and paid for about 40 acres of this tract, and negotiations concluded for the balance, with the exception of two small lots which it is still possible to obtain under the authority given.

Nahant.—On January 4, 1898, the officer in charge was requested to submit recommendations as to the area of land at Nahant which should be obtained, also names of owners and prices, with a map of the land and all necessary information for presentation to the Secretary of War.

At the close of the year some information had been accumulated and measures had been taken to secure an early report.

The following allotments have been made:

For acquisition of land on Peddocks Island:		
Act June 6, 1896		$33,130.00
For purchase of site at Nantasket Head, Hull, Mass.:		
Act June 6, 1896	$185,160.79	
Act March 3, 1897	64,839.21	
Act March 3, 1897	1,248.85	
		251,248.85
Total		284,378.85

Money statement.

July 1, 1897, balance available	$283,130.00
Expended during fiscal year	224,582.34
July 1, 1898, balance available	58,547.66

Preservation and repair of fortifications.—Under a joint resolution of Congress, approved May 1, 1890, Castle Island, the site of one of the works of the old type, was turned over to the city of Boston for park purposes. The fort and batteries were retained and the public excluded therefrom.

Under the approval of the Chief of Engineers, dated May 27, 1897, one of the works of old type was established headquarters for the mine defense of Boston Harbor, for storing torpedo materials. Upon the receipt at the fort of explosives and other mining materials, purchased under the appropriation for "National Defense," act of March 9, 1898, the public was excluded from the site of the fort.

On December 24, 1897, an allotment was made from the appropriation for "Preservation and Repair of Fortifications." Under this allotment all mine cases were cleaned. All of the buoyant mine cases and about one-half of the ground mine cases were painted.

Money statement.

CLEANING AND PAINTING MINE CASES.

Allotted during fiscal year	$800.00
Expended during fiscal year	773.15
July 1, 1898, balance available	26.85

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4 C.

DEFENSES OF SOUTHEAST COAST OF MASSACHUSETTS AND RHODE ISLAND, AT NEW BEDFORD, MASSACHUSETTS, AND NEWPORT, RHODE ISLAND.

Officer in charge, Maj. Daniel W. Lockwood, Corps of Engineers; assistants, Capt. Charles H. McKinstry, Corps of Engineers, to January 23, 1898, Lieut. William J. Barden, Corps of Engineers, from March 14 to April 15, 1898, Lieut. William B. Ladue, Corps of Engineers, since April 15, 1898, and Capt. Chester Harding, Corps of Engineers, since May 9, 1898. Division Engineer, Brig. Gen. George L. Gillespie, U. S. Volunteers, Colonel, Corps of Engineers.

New Bedford, Mass.—Two emplacements for 8-inch rifles, disappearing carriages.—The construction of these emplacements under the provi-

sions of the act of Congress approved March 9, 1898, for "National Defense" was authorized under date of March 18, and one of the gun platforms was ready for the carriage on June 4, the other on June 25.

A complete plant had to be assembled and the first tools were not received until April 13. The erection of necessary buildings, putting up concrete mixer and derricks, and laying railroad track occupied the time to May 15, when the first material for concrete was received. Excavation for the eastern emplacement was commenced on May 16, for the western emplacement on June 2. At the close of the fiscal year the following had been accomplished:

Easterly emplacement: Excavation, 400 cubic yards; Portland cement concrete, 216 cubic yards; natural cement concrete, 871 cubic yards; Portland cement facing, 50 cubic yards.

Westerly emplacement: Excavation, 650 cubic yards; Portland cement concrete, 206 cubic yards; Portland cement facing, 18 cubic yards.

The estimated cost of the two emplacements complete, exclusive of electric lighting, is $81,127.20

Money statement.

June 30, 1898, amount allotted during fiscal year	$50,000.00
June 30, 1898, amount expended during fiscal year	15,843.04
July 1, 1898, balance unexpended	34,156.96
July 1, 1898, outstanding liabilities	19,532.90
July 1, 1898, balance available	14,624.06

Mounting 8-inch converted rifles.—During May, 1898, the Commanding General, Department of the East, upon representation of the Governor of Massachusetts, sent two 8-inch converted rifles and carriages to be mounted for use for the better protection of the city of New Bedford, Mass.

By Department indorsement of June 3, 1898, authority was received to prepare emplacements and mount the above-mentioned guns on timber platforms, under the provisions of the act of Congress approved March 9, 1898, for "National defense."

Arrangements have been made for the pintles and traverse rails, although they have not been received as yet.

The estimated cost of this work is $1,800.

Money statement.

June 30, 1898, amount allotted during fiscal year	$1,800.00
July 1, 1898, balance unexpended	1,800.00

Torpedo defense.—Under the provisions of the act of Congress approved March 9, 1898, for "National Defense," it is proposed to close the harbor of New Bedford, Mass., by planting mines.

There being no mining casemate in this locality, a small building to be used as such was commenced on the 23d of June. The concrete foundation for engine and dynamo are completed. Up to the end of the fiscal year sufficient mining materials and supplies had not been received to warrant the commencement of planting the mines.

Money statement.

June 30, 1898, amount allotted during fiscal year	$5,000.00
June 30, 1898, amount expended during fiscal year	33.32
July 1, 1898, balance unexpended	4,966.68
July 1, 1898, outstanding liabilities	12.20
July 1, 1898, balance available	4,954.48

Narragansett Bay, R. I.—Mortar battery for sixteen 12-inch mortars.—Under the provisions of the act for "Gun and Mortar Batteries," approved June 6, 1896, it is proposed to construct a sixteen 12-inch mortar battery, at a cost of not to exceed $125,000. Allotments have been made as follows: July 24, 1896, $500, for preparation of plans and estimates; August 12, 1896, $20,000; September 19, 1896, $25,000; October 7, 1896, $80,000, and May 7, 1898, $10,000, for constructing work.

At the close of the fiscal year ending June 30, 1897, pits 2, 3, and 4 were completed and base rings set, and a part of the excavation for pit 1 had been made in rock. The excavation for the rest of the work was practically completed and about 5,000 cubic yards of natural cement concrete placed in the walls, footings, roof, pavements, etc., besides 755 cubic yards of Portland cement concrete in platforms.

The work was practically completed by June 30, 1898.

During the past fiscal year 5,230 cubic yards of natural cement concrete and 116 cubic yards of Portland concrete were placed; 1,956 square yards of pavement were laid in Portland cement.

The roof over the rooms, magazines, shell rooms, etc., were covered with natural cement mortar and then with a coating about one-half inch thick of rock asphalt, bitumen, and sand, in the proportion of 660 pounds of asphalt to 100 pounds of bitumen and 6 buckets of sand.

The work of constructing the earth parapet was commenced in December, 1897, and completed in June, 1898; 11,750 cubic yards of earth were placed and 45,207 square feet of slopes sodded.

Doors and trolleys were put in place as planned.

The carriages and mortars were mounted by engineer employees, and the former were in place during March, together with one mortar which had been received at that time. The other mortars required, fifteen in all, were received April 21 and the mounting of them was completed early in May.

The battery was wired and electric lights placed by the Newport Illuminating Company during May and June, and a contract has been made for the installation of a storage battery, to be charged, for the present, by the illuminating company, or until a suitable central electric-light plant is provided at the post.

The battery was turned over to the garrison on June 6, 1898.

Money statement.

July 1, 1897, balance unexpended	$72,763.85
Amount allotted since	10,000.00
	82,763.85
June 30, 1898, amount expended during fiscal year	74,526.14
July 1, 1898, balance unexpended	8,237.71
July 1, 1898, outstanding liabilities	3,323.48
July 1, 1898, balance available	4,914.23

Contracts in force during the fiscal year.

Contractor.	Nature of contract.	To commence.	To complete.
J. K. Sullivan	Furnishing sand	Oct. 15, 1896	When needed.
Brown & Howard	Furnishing stone	Oct. 10, 1896	Do.
Lawrenceville Cement Co.	Furnishing American Rosendale cement	do	Do.
Atlas Cement Co.	Furnishing American Portland cement	Nov. 10, 1896	Do.

Range-finder tower.—Under date of December 15, 1896, an allotment was made from the act for "Gun and Mortar Batteries," approved June

6, 1896, for the construction of a tower for the temporary installation of a Lewis range finder. The construction of this tower was completed in March, 1897.

Under date of April 28, 1898, authority was received to sheathe the range finder tower with 12 inches of timber and steel plates. This covering has been completed and painted with two coats of paint.

Money statement.

June 30, 1898, amount allotted during fiscal year	$2,300.00
June 30, 1898, amount expended during fiscal year	1,913.76
July 1, 1898, balance unexpended	386.24
July 1, 1898, outstanding liabilities	71.58
July 1, 1898, balance available	314.66

Two emplacements for 10-inch rifles, disappearing carriages.—The construction of these emplacements, under the provisions of the act of Congress approved March 9, 1898, for "National Defense," was authorized under date of March 18, 1898, and the plans and estimates approved under date of March 30, 1898.

Work was commenced immediately, and the excavation, largely in rock, practically completed by May 23. Gun platform No. 1 was reported ready for carriage and guns on May 2, and the same were mounted June 1. Gun platform No. 2 was reported ready on May 14, but the carriage for it has not been received, although the gun is on the ground.

The concrete plant that had been used in the construction of the mortar battery has been used at this work.

Excavation: The excavation for the foundation of the battery was commenced April 7 and was actively carried on both night and day until May 23, when it was practically completed, excepting as to the slopes of the roadway in the rear. The northern half of the excavation was in earth, the bottom being of hard, compact clay and bowlders overlying the rock, and about three-fourths of the southern half was in rock, the greater portion of which was from 10 to 12 feet in depth. About 2,250 cubic yards of rock were removed and wasted on the shore of the bay, and 3,000 cubic yards of earth were removed and deposited where it can be placed conveniently in the earth parapet.

Drainage: A main drain of 8-inch glazed sewer pipe has been laid from a manhole in the rear of emplacement No. 2 (the south gun) to a manhole in the rear of emplacement No. 1, and from thence to the shore of the bay. The total length of this drain is 510 feet. Both gun platforms and loading platforms are connected with the manholes by 4-inch drains of heavy cast-iron water pipes. A system of 3 and 4 inch porous tile drains laid in trenches filled with broken stone connects all the rooms and passages and an air space surrounding them with the manholes. Grated openings will be laid in each room covering connections with the drains.

Forming: All the forming below the level of the platforms has been completed, and that for the ammunition lifts, the parapet, and a portion of the traverse walls about emplacement No. 1 has been put up.

Steel beams: The steel beams for covering the rooms and passages have been received and put in place.

Concrete work: All concrete work below the level of the ceilings of the rooms and passages has been completed excepting the retaining wall at the south end of the roadway. The loading platform at emplacement No. 1 has been raised to within 6 inches of its full height.

Concrete has been placed over the rooms under the loading platform for emplacement No. 2, and is ready for the asphalt covering. The following amounts of concrete have been placed: Rosendale cement, 727 cubic yards in walls, the exposed surfaces faced with Portland cement mortar; Rosendale cement, 1,856 cubic yards in parapet and traverses, 193 cubic yards in loading platform No. 1; Portland cement, 360 cubic yards in gun platforms, 20 cubic yards in loading platform No. 1. In addition to the above, 945 tons of large stone have been built into the concrete of the parapet.

A layer of asphalt, coal tar, and sand about one-half inch in thickness was introduced in the concrete over the rooms and passageways, with a slope draining into the air spaces.

The estimated cost of the two emplacements, exclusive of lifts and trolleys, is $74,133.19.

Money statement.

June 30, 1898, amount allotted during fiscal year	$74,000.00
June 30, 1898, amount expended during fiscal year	28,535.32
July 1, 1898, balance unexpended	45,464.68
July 1, 1898, outstanding liabilities	23,556.81
July 1, 1898, balance available	21,907.87

Emplacements for two 4.7-inch R. F. guns.—The construction of these emplacements under the provisions of the act of Congress approved March 9, 1898, for "National Defense," was authorized under date of April 13, 1898, and the platforms were ready to receive the guns on May 23. At the close of the fiscal year the work had been completed to within about 2½ feet of the top. About 693 cubic yards of natural cement concrete and 100 cubic yards of Portland cement concrete had been placed in the work. The ceilings of the magazines and bomb-proof rooms were formed with heavy railroad iron.

The magazines are surrounded on three sides with air spaces. A layer of asphalt, coal tar, and sand was introduced in the concrete over the magazines and bomb-proofs, the former having a slope draining into the air spaces and the latter over the rear walls.

A main drain of 6-inch glazed tile 76 feet long has been laid from a manhole in the rear of the north magazine to an old manhole having direct connection with the bay. Two hundred and thirty feet of 3 and 4-inch porous tile drains have been laid in trenches filled with broken stone, and connect the air spaces and rooms with the manhole.

There remains to be done to complete these emplacements the completion of the covering of the magazines and walls of the observation stations, the construction of stairways leading to the magazines and concrete retaining walls, the construction of concrete aprons in front of guns and the excavation of about two-thirds of the roadway, and grading earth slopes.

The cost of the emplacements is estimated at $16,000.

Money statement.

June 30, 1898, amount allotted during fiscal year	$12,000.00
June 30, 1898, amount expended during fiscal year	5,804.80
July 1, 1898, balance unexpended	6,195.20
July 1, 1898, outstanding liabilities	3,950.50
July 1, 1898, balance available	2,244.70

Emplacement for one 8-inch B. L. rifle.—Under the provisions of the act of Congress approved March 9, 1898, for "National Defense," authority was received in April, 1898, to construct an emplacement for mounting one 8-inch breech-loading rifle on a strengthened barbette carriage. The emplacement, platform, and magazines in connection with this work have been completed. The necessary changes to be made in the 15-inch gun carriage for the 8-inch B. L. rifle were begun on June 8. The carriage is in readiness for mounting the rifle. This completes all work, with the exception of certain bolts, braces, etc., which were found lacking, and these will be supplied and put in place at an early date.

Money statement.

June 30, 1898, amount allotted during fiscal year	$3,000.00
July 1, 1898, balance unexpended	3,000.00

Preservation and repair of fortifications.—Estimates were submitted in December, 1896, for preservation and repairs needed up to June 30, 1898, and in June, 1897, an allotment of $2,000 was made from the appropriation for "Preservation and Repair of Fortifications," act of March 3, 1897, for rebuilding the breast wall in front of platforms 405 and 406 and for the reconstruction of the parapet in front of platforms 407 and 408. This work was completed in October, 1897.

The earth slope in front of the emplacements for 8-inch converted rifles was raised 8 inches and sodded. The area sodded was about 800 square yards.

In November, 1897, authority was received to repair the brick walk leading to the sally port. A portion of the pavement which had settled and allowed the accumulation of water was taken up and relaid with grade sufficient to carry off the water into the drain under the pavement, the work being completed in November, 1897.

In February, 1898, authority was received to repair a break in the sea wall at the mouth of the cable gallery, caused by a severe storm. These repairs were made in March, 1898.

In April, 1898, authority was received to repair platforms of the 8-inch converted rifles. The work of removing unserviceable wooden platforms was commenced on April 17, and new platforms to replace them were completed May 2, 1898. The platforms are of a timber grillage composed chiefly of 10-inch by 10-inch hard-pine timber resting upon a foundation of Portland cement concrete 2 feet thick, the spaces between the timbers being filled with concrete to the level of the top timbers, and slope slightly to provide for drainage to the rear. The old traverse-rail pintles and pintle plates were used. About 46 cubic yards of concrete and 7,623 feet of hard-pine timber were used.

Authority was received in May, 1898, to increase the earth covering of the magazines for the 15-inch and 8-inch converted rifles in the water battery. The work of covering these incomplete magazines of the old exterior battery with earth was commenced May 1 and completed June 10, 1898. About 2,500 cubic yards of earth were placed over the magazines and sodded with 1,560 square yards of sod.

The bill in equity brought to have the true boundary line of the reservation determined is still pending in the United States circuit court. Nothing has been done in regard to this matter during the past year.

Money statement.

July 1, 1897, balance unexpended	$2,861.77
Amount allotted since	5,700.00
	8,561.77
June 30, 1898, amount expended during year	6,218.11
July 1, 1898, balance unexpended	2,343.66
July 1, 1898, outstanding liabilities	147.86
July 1, 1898, balance available	2,195.80

Three emplacements for 10-inch rifles, disappearing carriages.—Under the provisions of the act for "Gun and Mortar Batteries," approved June 6, 1896, it is proposed to construct by contract a three 10-inch gun battery. Allotments have been made from said act as follows: September 17, 1896, $400 for preparation of plans and estimates; December 10, 1896, $8,000 for contingencies; and on April 23, 1897, $91,000, and November 3, 1897, $12,000, for payments to contractor only, under the act of March 3, 1897.

Under dates of August 6, 1896, and September 11, 1896, the Chief of Engineers directed that plans and estimates in detail for emplacements for two 10-inch disappearing guns be prepared and submitted, and said plans were submitted and approved in October, 1896. Proposals for this work were opened on October 24, 1896, and the contract for the construction of the gun battery was awarded to Richard M. Dudley, of New York City, at the rate of $56,967 for two emplacements. An additional emplacement was authorized by Department letter of December 10, 1896, and contract entered into under date of December 24, 1896, for three emplacements complete, and approved by the Chief of Engineers, under date of January 8, 1897. Time of commencement, February 1, 1897. Time of completion, November 1, 1897; later extended to June 1, 1898.

A detailed survey of the site was made and platted in March, 1897. Plans and estimates for the three emplacements were prepared and submitted in April, 1897, and partially approved by the Chief of Engineers during the same month, and plans in accordance with directions of Department indorsement of April 3, 1897, were partially approved by Department indorsement of June 11, 1897.

Two of the old magazines being directly within the line of fire, their removal was determined on; and under date of May 4, 1897, a supplementary contract was entered into with the contractor for the removal of two old magazines, two gun platforms, etc., in all about 1,000 cubic yards of material, at the rate of $1.75 per cubic yard.

In March, 1897, the plant was installed. The old artesian well was cleaned out and its pump repaired. A cement shed of 3,000 barrels capacity was erected, the old buildings being used as dormitories and mess rooms.

All work under the contract was completed in May, 1898.

The total material and labor used in the construction and covered by the contract has been as follows:

22,119 cubic yards excavation, at 30 cents	$6,635.70
6,207 cubic yards embankment, at 25 cents	1,551.75
6,538 square yards sod, at 30 cents	1,961.40
390 cubic yards broken stone, at $2.50	975.00
10,971 cubic yards natural cement concrete, at $5.40	59,243.40
653 cubic yards Portland ordinary concrete, at $7.40	4,832.20
351 cubic yards Portland granolithic concrete, at $8.40	2,948.40
448 cubic yards Portland cement facing, at $11	4,928.00

1,437¼ tons stone in mass of concrete, at $1.90	$2,731.25
55,668 pounds steel I-beams, at 2¾ cents	1,530.87
6,264 pounds steel anchor bolts, at 3½ cents	219.24
11,394 pounds steel trolley beams and trolleys, at 4 cents	455.76
2,689 feet B. M. white pine in doors, at 20 cents	537.80
843 feet B. M. white pine electric-light strips, at 20 cents	168.60
2,216 pounds brass door fittings, at 30 cents	664.80
460 linear feet 1½-inch galvanized-iron pipe, at 25 cents	115.00
12 cubic yards granite steps, at $27	324.00
192 linear feet 4-inch cast-iron pipe, at 50 cents	96.00
697 linear feet 8-inch glazed sewer pipe, at 30 cents	209.10
768 linear feet 4-inch porous drain tile, at 8 cents	61.44
8.82 thousand brick in manholes and gutters, at $20	176.40
4 manhole covers, at $10	40.00
3 sets stairs and hand rails, at $100	300.00
3 sets of four cages double lifts, at $1,700	5,100.00
1,845 cubic yards removal of old magazines, at $1.75	3,228.75
Total	99,034.86

During the months of March and April, 1898, the carriages and guns were received. All three carriages and their respective guns have been successfully mounted in place by hired labor and use of the Government plant.

Under date of June 29, 1898, the Chief of Engineers authorized the installation of a storage battery, this battery to have a capacity for 41 lamps with an 8-hour discharge. This battery is for the use of the three emplacements. Aside from the installation of the electric lighting plant, all work in connection with the battery has been completed.

Money statement.

July 1, 1897, balance unexpended	$88,927.13
Amount allotted since	12,000.00
	100,927.13
June 30, 1898, amount expended during fiscal year	97,798.49
July 1, 1898, balance unexpended	3,128.64
July 1, 1898, outstanding liabilities	142.52
July 1, 1898, balance available	2,986.12

Mortar battery for eight 12-inch mortars.—Under date of June 7, 1898, the Chief of Engineers directed that plans and estimates in detail for emplacements for eight 12-inch mortars be prepared and submitted. A survey of the proposed site had been made and plans and estimates are being prepared.

Money statement.

June 30, 1898, amount allotted during fiscal year	$2,500.00
June 30, 1898, amount expended during fiscal year	646.40
July 1, 1898, balance unexpended	1,853.60
July 1, 1898, outstanding liabilities	172.15
July 1, 1898, balance available	1,681.45

Emplacement for one 6-inch rapid-fire gun.—The construction of this emplacement under the provisions of the act of Congress approved March 9, 1898, for "National Defense," was authorized under date of April 25, 1898.

Under date of May 2, 1898, authority was received to accept the proposition of the Nassau Construction Company (whose plant was already on the ground) for constructing the emplacement, and work was commenced immediately.

By the 1st of June the emplacement had been completed in every detail and the gun can be mounted at any time.

The total cost of the material and labor used in the construction of this emplacement has been as follows:

1,155 cubic yards excavation, at 75 cents	$866.25
725.2 cubic yards Rosendale concrete, at $5.75	4,169.90
170.5 cubic yards Portland concrete, at $8.40	1,432.20
33.1 cubic yards Portland cement facing, at $12	397.20
4.5 feet galvanized iron pipe, 1½ inches, at 30 cents	1.35
11,343 pounds I-beams in place, at 3 cents	340.29
2 doors, 134 feet B. M. lumber, at 40 cents	53.60
250 cubic yards earth fill, at 50 cents	125.00
85 pounds brass gudgeons, hinges, and fittings for doors, at 49 cents	41.65
468 square yards sod, at 30 cents	140.40
15 feet 2-inch iron pipe, at 25 cents	3.75
1 set galvanized-iron hand rails	40.50
Bridge	5.00
73 feet B. M. electric-light strips, at 20 cents	14.60
461 feet tile and glazed pipe drain, at 10 cents	46.10
Setting anchor bolts and plates	9.16
Asphalting	32.92
Total	7,719.67

Money statement.

June 30, 1898, amount allotted during fiscal year	$8,000.00
June 30, 1898, amount expended during fiscal year	7,830.61
July 1, 1898, balance unexpended	169.39
July 1, 1898, outstanding liabilities	102.00
July 1, 1898, balance available	67.39

Two emplacements for 12-inch rifles, nondisappearing carriages.—The construction of these emplacements under the provisions of the act of Congress approved March 9, 1898, for "National Defense," was authorized under date of April 25, 1898, and the necessary plans prepared and approved.

A complete plant has been purchased and assembled, and all temporary buildings erected, and an agreement for constructing a pile dock in the cove north of the site has been made with a local contractor and about three-quarters of the piles have already been driven. It is expected that this wharf will be so far completed by July 15 as to allow of the landing of material.

Up to the end of the fiscal year the following work has been done:

Excavation: On June 10, the work of stripping the rock of its thin covering of sod and earth was begun. The surface of the rock is extremely uneven and full of pockets, rendering this work of cleaning quite expensive. On June 17, two Ingersoll-Sergeant drills were put to work and on June 21, two more drills were added and a night force of drillers put to work. On the 22d a force of excavators was added to the night shift, since which time the work has been pushed twenty hours a day with all the force that could be used to advantage in an effort to complete the excavation so far as necessary for the masonry, before it becomes necessary to mount other machinery than steam drills. The bulk of the excavation is in a bastard granite, full of seams and cracks. The drilling is quite difficult, but the blasting is fairly good. Much care is used in blasting owing to the proximity of residences. The excavation for emplacement No. 1 is complete; that for No. 2 is complete for its magazine and shell rooms and to a line just beyond the gun platform. The material excavated has been utilized

in making an approach to the new dock, and in filling, leveling, and enlarging the low land lying just north of the work.

Concrete: No concrete of any kind has been laid. Circles for forms for gun platforms have been made. Proposals for the supply of cement, crushed stone, large stone, and sand have been received, but as yet no awards have been made.

The cost of these emplacements is estimated at $99,649, exclusive of the cost of leveling the old fort.

Money statement.

June 30, 1898, amount allotted during fiscal year	$40,000.00
June 30, 1898, amount expended during fiscal year	3,569.09
July 1, 1898, balance unexpended	36,430.91
July 1, 1889, outstanding liabilities	12,009.35
July 1, 1898, balance available	24,421.56

Cable tank.—Under date of August 14, 1896, and March 22, 1897, the Chief of Engineers directed that detailed estimates be prepared and submitted for the cost of constructing a tank for the wet storage of cable at Narragansett Bay, R. I. Plans and estimates were submitted in May, 1897, and approved the same month, the work to be done by hired labor and use of Government plant.

At the commencement of the fiscal year all excavation work had been completed and a portion of the building materials received.

During the year: The side walls of the tank were completed in July, 111 cubic yards of concrete being used therefor. In August and September the bottom of tank was completed, shed over same built and painted inside and out. No actual work was done during the winter months, but the railroad track, cars, transfer, traveler, and necessary blocks for traveler and moving transfer car were purchased and received. By April, 1898, all minor details connected with this work had been completed, the total cost being $4,000.

The following materials were used in the construction of this work:

26,623 feet B. M. lumber.
15,000 shingles.
315 barrels cement.
120 cubic yards crushed stone.
80 cubic yards sand.
155 railroad ties.
545 pounds nails, etc.
66 gallons paint.

Money statement.

July 1, 1897, balance unexpended	$3,715.25
June 30, 1898, amount expended during fiscal year	3,709.92
July 1, 1898, balance unexpended	5.33
July 1, 1898, outstanding liabilities	5.33

Torpedo defense.—Under the provisions of the act of Congress approved March 9, 1898, for "National Defense," it is proposed to close Narragansett Bay, Rhode Island, by placing mines in the eastern and western entrances.

Owing to dampness and the limited space in the mining casemates, authority was granted in May, 1898, to remove the instruments, etc., from the casemates to small buildings erected near by.

Arrangements were made for installing search-light plants, the necessary buildings for protecting the plants having been erected.

Mines have been planted in the eastern and western passages. The groups reported as planted have been from time to time in perfect working order, but constant repairs seemed to be necessary, particularly in the eastern passage, to maintain them in such condition, due to injuries from passing vessels and from wear and deterioration of joints.

The above work of planting mines was completed on May 11, 1898, and since that date no boats have been allowed to pass through the mine fields between the hours of 8 p. m. and 4 a. m., with the exception of two regular lines of steamboats.

Money statement.

June 30, 1898, amount allotted during fiscal year	$11,000.00
June 30, 1898, amount expended during fiscal year	8,174.20
July 1, 1898, balance unexpended	2,825.80
July 1, 1898, outstanding liabilities	2,681.16
July 1, 1898, balance available	144.64

Sites.—Under the provisions of the act of Congress of August 18, 1890, the Chief of Engineers, under date of August 6, 1894, directed that negotiations be opened for the purchase of certain land needed for projected fortification purposes. It being found after a long period of negotiations that there was no prospect of securing certain portions of the property by amicable arrangements, the owners were notified in March, 1897, that title on the part of the United States would be acquired by condemnation. A report on the rearrangement of the batteries and the areas of land to be acquired was submitted on June 30, 1897. In July, 1897, investigations were made as to the feasibility and probable cost of extinguishing the right of way between the proposed site for the 10-inch and 12-inch gun batteries and the report submitted thereon. Under date of August 11, 1897, the Secretary of War requested the Attorney-General to institute proceedings for the condemnation of certain tracts of the land, and also of the public road between abutting tracts. In September, 1897, authority was received to have certain additional lines, in connection with a former survey of the locality run out, in order to complete the information required by the United States district attorney before commencing condemnation proceedings, and this information, covering 23.068 acres of land sought to be acquired, was transmitted to the United States district attorney in October, 1897.

In June, 1898, information was received from the United States district attorney that he had received instructions to institute proceedings for the condemnation of two additional tracts of land, one of 7.354 acres and one of 2 acres.

In May, 1897, authority was received to make a survey of another site, with a view of determining whether there will be sufficient room for mounting the guns recommended by The Board of Engineers.

Money statement.

July 1, 1897, balance unexpended	$134,127.94
June 30, 1898, amount expended during fiscal year	55.50
July 1, 1898, balance unexpended	134,072.44

4 D.

DEFENSES OF EASTERN ENTRANCE TO LONG ISLAND SOUND AND COAST OF CONNECTICUT.

Officer in charge, Maj. Smith S. Leach, Corps of Engineers; assistant, Lieut. William J. Barden, Corps of Engineers, to March 14, 1898, and since April 15, 1898; Division Engineer, Brig. Gen. George L. Gillespie, U. S. Volunteers, Colonel, Corps of Engineers.

DEFENSES OF NEW LONDON.

On the west side of harbor.—Aside from ordinary deterioration three has been no change in the condition of this work during the year.

With funds from the appropriation for "National Defense," act of March 9, 1898, a 15-inch smoothbore gun in the north exterior battery was moved from the emplacement nearest the enceinte to the one adjacent. The platform was prepared by the Engineer Department and the moving and mounting were done by the garrison. Two 15-inch smoothbore guns with carriages were received from Fort Washington. Platforms were prepared and the guns and carriages moved from the dock to the platforms by the Engineer Department. The carriages and guns were mounted by the garrison. No other changes were made in the armament.

On the east side of harbor.—The condition of the work has been improved during the year by the presence and labors of a garrison for a short period.

Under an allotment of $33.50 for renewing coal bin and parapet steps lumber was purchased for the purpose, the labor to be supplied by the ordnance sergeant.

Under a project for temporary batteries at other points, all the 10-inch guns, eleven in number, were removed from the work with their carriages. The platforms were not disturbed. No other changes were made in the armament.

Money statement.

July 1, 1897, balance unexpended	$46.00
July 15, 1897, deposited to credit of Treasurer United States	46.00
January 7, 1898, amount allotted from appropriation for Preservation and repair of Fortifications	33.50
June 30, 1898, amount expended during fiscal year	31.83
July 1, 1898, balance unexpended	1.67
July 1, 1898, outstanding liabilities	1.67

DEFENSES OF THE EASTERN ENTRANCE TO LONG ISLAND SOUND.

Emplacements for two 12-inch B. L. rifles on United States disappearing carriages, model 1897.—At the beginning of the fiscal year, under a contract with J. W. Hoffman & Co., of Philadelphia and New York, a dock had been substantially completed, plant installed, and excavation for concrete finished.

The contract expired November 1, 1897, at which date, owing to delay in completing the dock for reception of materials, about a month's work remained to be done. The contract was extended, at contractors' cost, to June 30, 1898. Work was resumed about May 1, and the contract was completed at the close of the fiscal year, but the work had not been finally accepted.

These two 12-inch emplacements are now ready for armament.

Money statements.

CONTRACT.

July 1, 1897, balance unexpended		$107,587.32
June 30, 1898, amount expended during fiscal year		84,308.51
July 1, 1898, balance unexpended		23,278.81
July 1, 1898, outstanding liabilities	$13,860.04	
July 1, 1898, amount covered by uncompleted contracts	9,418.77	
		23,278.81

ENGINEERING, SUPERVISION, ETC.

July 1, 1897, balance unexpended	$8,015.43
June 30, 1898, amount expended during fiscal year	7,933.61
July 1, 1898, balance unexpended	81.82

Abstract of proposals for electric lighting and power installation, opened March 3, 1898, by Maj. Smith S. Leach, Corps of Engineers.

No.	Name and address of bidder.	Oil engine and belt.	Electrical plant.	Entire plant.
a 1	McCay-Howard Engineering Co., Baltimore, Md.			$5,290
2	New Jersey Foundry and Maching Co., New York, N. Y		$3,000.00	
3	The De LaVergne Refrigerating Machine Co., New York	$2,410		
4	Westinghouse, Church, Kerr & Co., New York, N. Y:			
	Westinghouse gasoline engine with belt—			
	No. 1	2,100		
	No. 2	2,200		
	No. 3	3,068		
5	Randall P. Barron, New York		3,285.00	
6	Sprague Electric Co., New York		2,941.50	

a Accepted.

Contracts in force during the fiscal year.

With J. W. Hoffman & Co., New York, N. Y., for building two 12-inch gun emplacements. Contract entered into December 11; approved December 31, 1896; work began May 1; expiration, November 1; extended October 23, 1897; new date of expiration, June 30, 1898.

With McCay-Howard Engineering Company (McCay Engineering Company), Baltimore, Md., for electric lighting and power installation. Contract entered into April 30; approved May 19; work began June 15; expiration, July 15, 1898.

Emplacements for two 10-inch B. L. rifles on United States disappearing carriages, model 1896, and a mining casemate.—At the beginning of the fiscal year advertisements were running for proposals for this work. Bids were opened July 28, and a contract entered into with Mairs & Lewis, of New York, the lowest bidders, at prices aggregating, for estimated quantities, $75,727 for the emplacements and the casemate, and $26,700 for a dock, the latter a substantial breakwater pier. Work under the contract was to be begun within thirty days after notice of award and completed before June 30, 1898.

Work was begun with commendable promptness and prosecuted vigorously until the excavation was completed. When this stage was reached, and concrete work should have begun, the lack of competent direction became apparent, and has continued so.

A stonecrusher, concrete mixer, and derricks were installed, and a small quantity of concrete made before closing down for the winter. Operations were resumed early in the spring, the frost risk being assumed by the United States to facilitate progress.

A damp-proof course over magazines and passages, not provided for in the original contract, was introduced. The contractor was also required to move and mount a carriage, and was permitted to supply materials and labor for a *rapid-fire* emplacement.

At the close of the fiscal year, and the expiration of the original contract, the work was but little more than half done in point of quantity, though considerably more than half done in point of time and expenditure. An extension of sixty days was asked and granted, the first two weeks to be at the cost of the United States for inspection, on account of delay to the work by the introduction of the damp-proof course.

The gun platform of No. 2 emplacement was completed on May 19, and that of No. 1 on June 28. One carriage reached the island on May 21, and its removal to the platform began at once, working day and night. The carriage was moved over a horizontal distance of 513 yards and through a vertical distance of 52 feet. The base ring reached the platform June 1, was set June 11, and the carriage was completely mounted June 25. Work was done by the contractor at an agreed price of $1,075. In addition, the United States supplied timber costing $520, which is available for future work of the same character.

At the close of the fiscal year the lower of the two emplacements was up to subgrade, 2 feet below final grade, and the upper one was up to ceiling level, with part of the roof beams set and covered. A little excavation only had been done on the mining casemate.

The plant employed by the contractor has comprised, at its maximum, a boiler plant and pumps, a Gates crusher, a Cockburn-Barrow continuous concrete mixer, and five guy derricks. Stone for the crusher, and also the large stone for concrete, is obtained from bowlders on the site, which are broken up with dynamite and handled by teams. The sand is also obtained on the beach, and is hauled in carts.

The contract included a dock, and no especial requirements as to the date of its completion were introduced, as it was supposed the contractor's self-interest would induce him to push it to completion in order to profit by its use. On the contrary, it was not completed until after the close of the fiscal year, and all of the contractor's freighting has been done by lighters and small boats at a great expense.

Money statements.

CONTRACT.

August 12, 1897, amount allotted for two 10-inch emplacements and a wharf		$99,000.00
June 30, 1898, amount expended during fiscal year		37,338.47
July 1, 1898, balance unexpended		61,661.53
July 1, 1898, outstanding liabilities	$17,438.72	
July 1, 1898, covered by contract	44,222.81	
		61,661.53

TORPEDOES FOR HARBOR DEFENSE.

July 1, 1897, balance unexpended		$11,000.00
June 30, 1898, amount expended during fiscal year		634.63
July 1, 1898, balance unexpended		10,365.37
July 1, 1898, outstanding liabilities	$21.60	
July 1, 1898, covered by contract	10,343.77	
		10,365.37

MOUNTING AND MOVING GUNS.

June 16, 1898, amount allotted		$2,750.00
June 30, 1898, amount expended during fiscal year		1,482.30
July 1, 1898, balance unexpended		1,267.70
July 1, 1898, outstanding liabilities	$164.70	
July 1, 1898, amount involved	1,103.00	
		1,267.70

ENGINEERING, SUPERVISION, ETC.

July 1, 1897, balance unexpended	$10,000.00
June 30, 1898, amount expended during fiscal year	7,510.64
July 1, 1898, balance unexpended	2,489.36
July 1, 1898, outstanding liabilities	650.00
July 1, 1898, balance available	1,839.36

Abstract of proposals for constructing gun emplacements and a mining casemate, opened by Maj. Smith S. Leach, Corps of Engineers, June 28, 1897.

No.	Name and address of bidder.	Emplacements and casemate.	Wharf.	Total.
1	Manhattan Concrete Co., New York	$104,317.00	$27,950.00	$132,267.00
a2	Mairs & Lewis, New York	75,727.00	26,700.00	102,427.00
3	S. & E. S. Belden, Hartford, Conn	130,436.00	25,755.00	156,191.00
4	Henry C. Moore, New York	84,431.00	21,337.50	105,768.50
5	Brown & Connell, New York	124,355.00	33,107.50	157,462.50
6	Wm. A. Chapman, Providence, R. I	105,673.60	23,987.50	129,661.10
7	Pat. H. Fitzgerald, New London, Conn	111,525.22	26,950.00	138,475.22
8	J. W. Hoffman & Co., Harrison Building, Philadelphia, Pa	102,472.20	25,360.00	127,832.20

a Accepted.

Abstract of proposals for electric lighting and power installation, opened by Maj. Smith S. Leach, Corps of Engineers, March 24, 1898.

No.	Name and address of bidder.	Hornsby-Akroyd oil engine, with belt.	Electric apparatus, complete.	Total.
1	Clark & Mills, Boston, Mass	$2,000.00	$3,150.00	$5,150.00
2	Geo. F. Woolston, New York	a1,695.00	3,092.00	4,787.00
3	New Jersey Foundry and Machine Co., New York	1,831.00	a 2,710.38	4,541.38
4	Sprague Electric Co., New York	1,832.00	3,140.00	4,972,00
5	J. F. Buchanan & Co., New York	2,222.00	3,333.00	5,555.00
6	De La Vergne Refrigerating Co., New York	1,832.00	.....	1,832.00
7	Brown Electrical Construction Co., New Haven, Conn	1,832.00	4,500.00	6,332.00
8	McCay Engineering Co., Baltimore, Md	1,832.00	2,997.00	4,789.00
9	Manhattan Supply Co., New York	.....	2,895.00	2,895.00

a Lowest bids. Recommended for acceptance. Aggregating $4,405.38. Amount available for above work, $4,500.

Contracts in force during the fiscal year.

With Mairs & Lewis, New York, N. Y., for building two 10-inch gun emplacements and a mining casemate; contract entered into August 11, approved August 28; work begun September 10, 1897; expiration, June 30, extended to August 31, 1898.

With New Jersey Foundry and Machine Company, New York, N. Y., for electrical apparatus; contract entered into April 6, approved April 23; work begun June 15; expiration, July 15, 1898.

With George F. Woolston, New York, N. Y., for furnishing a Hornsby-Akroyd oil engine and belt; contract entered into April 8, approved April 22; work begun June 15; expiration, July 15, 1898.

Temporary defenses at Bridgeport, New Haven, New London, and Stonington.—On March 26, 1898, under instructions from the Chief of Engineers, a project was submitted for the temporary defense of the vulnerable points of the Connecticut coast of Long Island Sound by the erection of temporary batteries to mount 10-inch smoothbore Rodman guns. Eleven of these guns with carriages were on hand at Fort Griswold, where they could not be used effectively. The project also included the employment of batteries of siege guns at threatened

points, and the signaling and logistic problems incidental to their use and to the effective disposition of infantry supports. The project was approved, and an allotment of $20,000 was made from the appropriation for "National Defense," act of March 9, 1898, for its execution.

A chain of signal stations was established, occupying prominent points of the shore, extending from Fishers Island on the east to Long Neck on the west. The stations established were connected by telephone. Arrangements were made to have a trunk circuit placed under the exclusive control of the United States in case of necessity. The stations were in no case so separated by distance or intervening objects but that a vessel could be held constantly under observation from her appearance off the coast until she had passed the Connecticut-New York line.

Four 10-inch guns were mounted at Bridgeport, six at New Haven, and one at Stonington. Two of the guns at Bridgeport, two of those at New Haven, and the one at Stonington were placed behind breakwaters, using the existing structure partly as a foundation and partly as a parapet. The construction of the platform was similar in each case, and is shown in the accompanying sketch.* Two of the guns at Bridgeport and four of those at New Haven were mounted behind temporary parapets of earth supported by a breastheight of railroad ties and rails disposed as shown in the accompanying sketch.* The arrangement provides recesses in the breastheight for the ammunition at the gun during action. The guns were mounted on wooden platforms, the general arrangement of which is also indicated. In connection with this project, three platforms for 15-inch smoothbore guns were prepared at New London, and two carriages and guns were moved from the wharf to the vicinity of the platforms. The work on platforms consisted in setting pintle plates, pintle and traverse circles, which were on hand, but had not been placed.

Money statement.

April 2, 1898, amount allotted	$20,000.00
June 30, 1898, amount expended during fiscal year	14,822.41
July 1, 1898, balance unexpended	5,177.59
July 1, 1898, outstanding liabilities	5,177.59

Submarine mines.—Of the four principal Connecticut ports—Stonington, New London, New Haven, and Bridgeport—it was decided to close the first three by mines. Bridgeport has a channel which can easily be closed by inert obstructions. Mine cases, anchors, compound plugs, and some minor parts of the matériel (all old pattern) were supplied from the depot. The remainder of the system was improvised from such materials as could be readily obtained.

The system of operation adopted comprised a closed circuit of considerable resistance for testing and firing, with a shunt through the circuit closer for signaling. The circuits were separate for each mine. The connections in the casemate were made on a specially designed switch board, the elements of which, one for each mine, consisted of an ordinary numbered telephone drop and a single-throw switch of compact form, which in one position put the signal battery onto the mine circuit through the drop magnet and in the other threw the firing battery onto the mine circuit, cutting out signal battery and drop.

The mine could be fired by judgment purely, though such firing was

*Not published.

not contemplated. The method had in view was for the operator to watch the keyboard, and, when a contact was signaled by dropping the number, throw the corresponding switch and fire the mine. Six Edison-Lalande cells were used for signaling, and 180 chloride-accumulator, type D5, for firing battery. The latter was charged from a railroad circuit, using a step rheostat to adjust voltage. At New London the charging current was carried under Thames River on a No. 4 rubber-covered, braided telephone wire. At New Haven the circuit was carried on a similar wire from the shore, under the harbor, to the breakwater, and thence along the breakwater to the light-house at its end. The same wire of No. 14 gauge was used for mine circuits. It was coated with P. and B. paint, and stopped at short intervals to one-fourth inch galvanized-wire strand. Near the mine the strand and insulated wire were stopped continuously with rubber tape.

In the mine the connections were as usual, except that a 150-ohm German-silver coil was substituted for the 4,500-ohm coil and magnetic cut-out of the circuit regulator. The resistance of the drop magnet was 80 ohms and of the line, on the average, 10 ohms; hence the signal battery had to be worked on a closed circuit of about 15 ohms, varying slightly with the number of mines, which were in parallel as a signal circuit, and the firing battery on a circuit of 160 ohms.

Daily tests were made by measuring the resistance of each circuit and comparing the result with preceding values. When the resistance runs low the best results are obtainable by the use of a rather strong current. It was thought that if the current were increased in a ratio no greater than the fall of resistance due to the leaks the amount passing through the fuse would not be sensibly varied. This hypothesis is correct only for a leak or shunt between the battery and the fuse. One mine at New Haven exploded under test, apparently from the sticking of the circuit closer after the mine had been struck. This put the entire testing current through the fuse, and it happened to reach the exploding point, though only after several seconds of flow. After this accident the testing current was kept below the safe limit of the fuse, regardless of the change in resistance.

In this connection the officer in charge desires to acknowledge the very energetic and efficient service rendered by his military assistant, Lieut. W. J. Barden, Corps of Engineers, and by Prof. W. Lispenard Robb, of Trinity College, Hartford, and Prof. H. A. Storrs, of the University of Vermont, who, in the capacity of principal electricians, rendered services of conspicuous value. A report by Lieutenant Barden on the New London mining operations is herewith.

Money statement.

May 5, 1898, amount allotted from appropriation for "National Defense," act March 9, 1898		$15,000.00
May 25, 1898, amount allotted from same appropriation		5,000.00
June 10, 1898, amount allotted from same appropriation		2,000.00
June 29, 1891, amount allotted from appropriation for "Torpedoes for Harbor Defense, January 1, 1899," act of May 4, 1898		7,000.00
		29,000.00
June 30, 1898, amount expended during fiscal year		17,701.96
July 1, 1898, balance unexpended		11,298.04
July 1, 1898, outstanding liabilities	$2,865.04	
July 1, 1898, amount involved	8,433.00	
		11,298.04

REPORT OF SECOND LIEUT. WILLIAM J. BARDEN, CORPS OF ENGINEERS.

NEW LONDON, CONN., *June 2, 1898.*

MAJOR: I have the honor to make the following report on the submarine mining operations for the defense of New London Harbor:

In the beginning of these operations it seemed probable that none of the matériel of the approved system would be available for use here, and steps were accordingly taken to improvise the entire system. Subsequently some parts of the approved matériel were sent here, so that the system as finally adopted contains both approved and improvised matériel. The mine cases, compound plugs, circuit closers, anchors, shackles, mooring and anchor ropes used were those received from Willets Point; while the circuit regulators, cable, and matériel of the operating casemates were improvised.

The novel features introduced at your suggestion, as a result of the impossibility of securing the regular mining matériel, are:

First. The planting of the mines in two rows instead of in grand groups, the two rows and the mines in each row being 200 feet apart, those in the upper row being opposite the intervals of those in the first.

Second. The use of a separate circuit for each mine.

Third. The use of a circuit of low resistance, i. e., 150 ohms instead of one of 4,500 ohms.

Fourth. The use of a firing battery of sufficient strength to fire the mine through the circuit regulator coil.

Fifth. The arrangement of switch board.

Sixth. The use of ordinary insulated wire stopped to wire strand instead of iron-armored cable.

A separate magnet and drop and switches for signal and firing battery circuits are thus required for each mine. The switch boards or operating boards are made in panels, each containing all the apparatus for twenty-five mines, arranged for convenience in groups of five. The signal battery and firing battery switches are so connected that the first is opened, and the second then closed, by one movement of the handle. The system is not designed for purely automatic firing, as it is not intended that the mines shall be fired through the circuit made by closing the circuit closer, but always through the 150 ohm resistance coil. Two methods of firing are possible: First, purely judgment firing, as in the typical system, with the advantage that only one mine is fired at a time; second, what may be termed contact judgment firing, in which the drop of the mine number and the ringing of a bell indicate the contact of a ship against the mine, which is then fired at will by the operator by merely closing the switch lever.

Six Edison-Lalande cells are used for the signal battery and 180 storage battery cells for the firing battery. The latter is charged from the street-railway power house in New London, by means of a No. 4 heavily insulated Habirshaw wire laid as a cable across the river to the operating casemate. The latter is located close to the water, but behind a railroad bank, which covers it from both view and fire from the water. It is a 12-foot by 12-foot frame building covered with tarred paper, and is fitted with all necessary testing and regulating instruments, i. e., volt meters, ammeter, circuit breaker, regulating resistance, galvanometers, and portable testing set, and is lighted by four 220-volt 10-candlepower incandescent lights.

Preparation of matériel.—The wire used as cable was first painted with P and B. insulating paint, and then fastened to a one-fourth-inch diameter wire strand at intervals of 10 feet. The latter is designed to relieve the cable from longitudinal strain, and to give sufficient weight to sink it. Fastenings were made by first wrapping with cloth tape, and then tying with copper binding wire. For 50 or 60 feet adjacent to the mine, where the wear and strains are greatest, this taping was made continuous. A Turk's head was made by wrapping the insulated wire with canvas, unstranding the wire strand, and then restranding it around the insulated wire, after which the two were taped and wrapped with canvas to the proper size for the collar. The Turk's head was then made in the usual manner.

Planting.—A scow lashed to a tug and large enough to carry all the mines, anchors, and matériel for a day's work was used for planting. The drum of cable was carried on a small steam launch. After a mine was planted the end of the short length of cable was passed to the men in the launch, who spliced the strand, jointed the insulated wire, and then ran the cable to shore. Twenty-three mines were planted in about thirty hours. The slow progress was due to the inexperience of the men and the difficulty of maneuvering the barge in a strong current. Two of the mines have since been knocked adrift by the propellers of passing steamers. Both were recovered, and it was found that the wire mooring rope had pulled out of the clips which are used to fasten it to the mine shackle.

Testing.—The most satisfactory daily test has been found to be the measurement of the resistance of the circuit of each mine. This can be quickly made with sufficient accuracy to determine the efficiency of the mine. The condition of mines

and cables to date has been on the whole satisfactory. In three cases where loss of insulation was indicated the fault has been located, and found to be in the cable in the mine cap. In two of these cases the cable had been sharply bent where it leaves the mine and the insulation broken at that point. In the third case the Turk's head was allowed to project so far inside of the cap that when the latter was fastened to the mine the Turk's head pressed against the cable and wore off the insulation. A quantity of armored cable is to be sent here and will be used to replace the temporary cable now in use as soon as it shows signs of deterioration.

In the work of preparation, planting, and testing, the amount of labor employed has been as follows:

	Days.
Principal electricians	56
Electricians	235⅝
Machinists	146
Riggers	40
Carpenters	15¼
Powderman	8⅝
Laborers	297
Watchmen	59½

These figures include the labor required for the preparation of about 20 miles of cable and preliminary work on sixty-three mines (i. e., cleaning and painting, loading and testing the compound plugs, cutting the mooring and anchoring ropes, and fastening them to the anchors), for use at New Haven Harbor.

Very respectfully, your obedient servant,

W. J. BARDEN,
Second Lieutenant, Corps of Engineers.

Maj. SMITH S. LEACH,
Corps of Engineers, U. S. A.

Emplacements for two 10-inch B. L. rifles on United States disappearing carriages, model 1896.—Telegraphic instructions to proceed to the construction of these emplacements were received late in the evening of Thursday, the 17th of March. On Friday and Saturday arrangements were made for supplying labor and procuring the necessary materials and plant. On Monday, the 21st, a small force of men was sent to the island, followed by a larger force with teams on the 22d. Work began on the night of the 22d with the full force of about 125 men and 12 teams. The excavation was confined to two rectangles sufficiently large to contain the gun platforms proper, and was pushed as rapidly as possible day and night. The excavation for the rear gun of the battery was completed on the 27th, and the laying of concrete began on the 28th. The gun platform of the rear emplacement was completed, except the granolithic finish, on the 5th of April, at which time the excavation for the front platform was finished. Work on that platform began immediately and was completed on the 12th of April. Inside of twenty working days two gun platforms were in readiness for carriages in a battery of full sunken construction involving nearly 15,000 yards of excavation.

By the time the second platform was finished, ground had been opened for beginning the terrepleins and foundations. Up to this time and for some days subsequently, concrete was made partly by hand and partly in the mixer of the contractors for the 12-inch emplacements, the latter being hauled in carts a distance of about 1,200 feet. During this time the installation of a concrete and transportation plant had been pushed with all possible energy. A cement house of 4,000 barrels capacity was built; a trestle of sufficient strength to carry a 7-ton locomotive was constructed to connect the dock with the concrete mixer; a Cockburn-Barrow continuous mixer was procured and installed with a boiler and pump. Derricks were procured and erected; cars and track material purchased, and on the 25th day of April, thirty-three days from the date of beginning, the concrete plant was put in operation. After a few days of experiment and training the work of concrete making and placing reached a daily rate of 200 yards in place

in ten hours. Until near the close of the work it was not found practicable to run the concrete plant more than ten hours daily on account of the difficulty of supplying material fast enough. The unloading facilities on the dock were inadequate, and could not be quickly enlarged; and the rate of the work practically depended upon the working of the derrick on the end of the dock. Toward the close of the work, when for various reasons a supply of material had been accumulated, the hours of concrete making were gradually extended to eighteen or twenty per day. A sketch* of the arrangement of the plant accompanies this report. Its main features were: First, the collection of materials in proper proportions for the mixer and their delivery on the platform by means of cars on a belt railroad; second, the delivery of the material, when mixed, in similar cars also on a belt road. The loaded cars were raised from the mixer on an incline to a point above the highest level of concrete in the work, from which point they ran by gravity to the dump and returned by gravity to the mixer. The material was deposited by carrying the loaded cars over the emplacements on a portable track supported by trestles, and dumping them where desired. The trestles were first placed about 4 feet above ceiling level for the lower part of the work, and later were raised to a level high enough to allow the concrete to be finished underneath them. The maximum fall of material from the cars was about 15 feet. This method was adopted with some apprehension, but experience with it shows that it is not at all objectionable, and in some respects advantageous.

In charging the mixer crushed stone was shoveled into a car to a certain mark, gauging its quantity, and this partly loaded car was then shoved along to cement platform, where the requisite charge of sand was shoveled in from one side, and 3 bags of cement emptied in from the other, the first bag being near the bottom, the second about the middle, and the third near the top of the charge of sand. This distribution gave a preliminary incorporation of sand and cement. The car was then run around to the platform and dumped. The materials at this stage were substantially unmixed. They were turned once with shovels, and then shoveled into the hopper by a peculiar motion, which was about equivalent to another turning. Under this arrangement the concrete came out in entirely satisfactory condition. The charge of water was regulated by a laborer, who had nothing to do but to keep his hand on a valve and see that the concrete went into the car at the proper consistency. When for any reason a portion of concrete came out too dry, it was found very convenient to moisten it by a fine spray from a nozzle attached by a short piece of hose to the supply pipe.

The elevated-track system for placing the concrete was more the outgrowth of forced conditions than of any conviction that its use would be advantageous. The emplacements occupy practically the entire width of the island at the point where they are situated, and there was no room for the guys of derricks. Three small stiff-legged derricks were erected, but their use was found so inconvenient on account of their small reach and necessity of frequent moving that they were finally abandoned. The overhead-track method proved to be exceedingly expeditious and convenient for placing concrete, but exactly the reverse of these conditions for handling the large stone. It was necessary to use stone of a size which could be dumped from the cars in the same way that the concrete was dumped, and even then much time was lost by precautions necessary to be taken to prevent the car from leaving the

* Not published.

track when the stone went off, and also from the necessity, in frequent cases, of moving a stone which did not fall properly, without any appliances other than men's hands and light crowbars. For these reasons the amount of such stone placed in the work was reduced to a minimum of between 10 and 12 per cent of the total volume of concrete. The percentage, however, where the stone was actually placed is larger, since its use was limited to the edges and top of the mass. No attempt was made to place it in the interior of the work.

The average weather during this construction was rather unfavorable. There were three heavy easterly storms of about a week each in duration, which caused almost complete suspension of work. The emplacements were substantially completed on the 25th of June, or three months and three days from the date of beginning. The work remaining to be done at the close of the fiscal year was the excavation of a road to the rear terreplein, the setting of doors, the placing of cranes and ammunition lifts, and hanging trolleys and blocks. The doors would have been in place had the parties who engaged to build them delivered them at the date agreed upon. The ammunition lifts were not ordered, as it was thought best to have a test of the worm and gear type in the 12-inch emplacements before ordering any more of that kind. With the lifts, through the motors, the electric plant was also involved in uncertainty, and its procurement deferred. At the expiration of three months from the date of beginning these emplacements, they were so far advanced that, had guns been mounted, ammunition could have been stored and served without serious inconvenience and the guns advantageouly worked.

This rate of progress is possible only under the conditions attendant upon this particular work. All the operations were regarded as emergent to the extent of dispensing with every element of delay in the procurement of materials and supplies. This necessarily entailed some expense, particularly in the matter of excavation, which, in order to permit the platforms to be begun at the earliest possible moment, was conducted in the least economical manner. It is interesting to know, however, that, when the conditions do justify such work, it can be done so rapidly. The increased expense, while appreciable, is not so great as would be supposed.

Time has not sufficed as yet to prepare a statement of the expenditures showing the itemized costs of different features of the work.

Money statement.

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

Gun emplacements.

March 18, 1898, amount allotted		$50,000.00
May 19, 1898, amount allotted		31,000.00
June 11, 1898, amount allotted		19,000.00
		100,000.00
June 30, 1898, amount expended during fiscal year		69,509.64
July 1, 1898, balance unexpended		30,490.36
July 1, 1898, outstanding liabilities	$22,000.00	
July 1, 1898, amount involved	8,490.36	
		30,490.36

Transporting guns.

June 10, 1898, amount allotted	$3,000.00
July 1, 1898, balance available	3,000.00

Search light.

June 10, 1898, amount allotted	$500.00
July 1, 1898, balance available	500.00

Emplacements for two 8-inch B. L. rifles on barbette carriages (15-inch smooth-bore converted).—Under date of April 27 the Chief of Engineers directed the construction of these emplacements. The letter was received on the afternoon of April 29. In the evening of the 30th a contract was closed for the construction of a pile dock. Piles were cut and hauled Sunday and Sunday night, the 1st of May, and on the 2d pile driving began at the point. As soon as the dock was sufficiently advanced to permit landing lumber carpenters were put ashore and the erection of buildings began. The dock was completed on the 21st of May, and machinery and timber were landed. By the close of the month a building for office and quarters, one for laborers and blacksmith shop, and a cement shed of 4,000 barrels capacity had been completed. A supply trestle was nearly done, track laid on the beach for building sea wall, temporary concrete platforms built, and a supply of sand and gravel collected. Forms were up for the left gun platform, and concrete mixing began on the 1st of June. The making and placing of concrete continued during the month, during the first half of which operations were carried on in the daytime only, but in the latter half some work was done at night. About 2,500 yards were placed, completing the left gun platform, except the additional mass to take the barbette carriage and bringing the parapet and rooms to ceiling level from the left flank to the right gun platform. About 800 tons of stone were landed on the dock, transported on cars under a derrick on the beach, and laid in the sea wall, covering about 160 feet of the front. Nearly as much was laid in the deeper water from a small scow carrying a derrick.

At this point concrete mixing is done by hand exclusively. The site is restricted in area and of low relief, not at all favorable for the installation of a concrete mixer. Materials are collected in a car in proper proportions and dumped on the mixing platform. Each car has a partition in it, forming two compartments proportioned in size to the volume of crushed stone and sand desired. The larger compartment is filled with stone from the pile under the trestle, the car is then pushed along opposite the cement house, where the sand compartment is filled from the sand pile and three bags of cement unopened thrown on top. When the car is dumped the stone and sand fall in separate piles. The sand and cement are dry-mixed and then formed into a circular ridge, making a basin or bowl, the proper proportion of water is placed inside of this and the mortar mixed with shovels. It is then spread out, the charge of stone shoveled on top of it, and the whole turned twice by hand.

Money statement.

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

April 27, 1898, amount allotted		$12,000.00
May 2, 1898, amount allotted		30,000.00
May 19, 1898, amount allotted		23,000.00
		65,000.00
June 30, 1898, amount expended during fiscal year		13,905.68
July 1, 1898, balance unexpended		51,094.32
July 1, 1898, outstanding liabilities	$15,000.00	
July 1, 1898, amount involved	36,094.32	
		51,094.32

Emplacement for a 4.7-inch rapid-fire gun.—Under date of March 19, the Chief of Engineers directed the construction of two emplacements for 4.7-inch rapid-fire guns. Final instructions were received on April 8. *Excavation* for the two emplacements was begun on the same day with

laborers furnished by the contractor for the 10-inch emplacements. Structural iron and some other materials for the two emplacements were purchased and delivered. On the 14th of April information was received from the Chief of Engineers that the assignment of guns to this locality had been canceled; but, in view of the probability that one gun could be obtained later, the construction of one of the emplacements was ordered continued and the other stopped.

During the month of April the excavation for No. 1 emplacement was completed, forms set, and about half the concrete laid. During May the concrete mass was completed, leaving only the granolithic finish to be placed, and the gun and carriage were received and mounted. The gun was ready for service on the morning of the 22d of May.

On account of the relatively small quantity of work involved and its isolated position, the expense of construction was relatively very great. The total cost of the emplacement will reach $9,000. As an example of the difficulties encountered, it may be stated that after experimenting in various directions it was found that the cheapest way to obtain aggregate for concrete was to break up bowlders on the site, the work being done by hand. All material used had to be hauled a mile over a sandy road.

Time has not permitted as yet a proper analysis of the expenditures to be made in form suitable for publication.

Money statements.

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

Gun emplacements.

April 6, 1898, amount allotted		$6,000.00
June 10, 1898, amount allotted		3,000.00
		9,000.00
June 30, 1898, amount expended during fiscal year		6,503.24
July 1, 1898, balance unexpended		2,496.76
July 1, 1898, outstanding liabilities	$2,193.95	
July 1, 1898, amount involved	302.81	
		2,496.76

Search light.

June 10, 1898, amount allotted	$650.00
July 1, 1898, balance unexpended	650.00

Purchase of sites for fortifications and seacoast defenses.—At the date of last Annual Report, a negotiation for purchase of a site containing about 225 acres having resulted in failure, proceedings for condemnation had been decided upon, and the petition filed. During the fiscal year a commission has been appointed, and has held frequent sittings at the site and in New York. At the close of the fiscal year the evidence was all in and arguments of counsel submitted.

About April 1, under instructions from the Chief of Engineers, negotiations were entered into, through a private agent, for the purchase of another tract of land required for defensive purposes on the north side of the entrance to the Sound. An option was secured for the purchase of three tracts, aggregating over 60 acres, at $5,500, the purchase to be consummated within three months. Under authority of the Secretary of War this option was closed by payment of $150. During the three months that the option ran the matter was placed in the hands of the Department of Justice, the title examined, deeds drawn and signed, and on the 30th day of June, the day on which the option expired, a payment of $5,650 was made, and the property passed to the ownership of the United States.

Money statement.

March 31, 1898, amount allotted	$5,650.00
June 30, 1898, amount expended during fiscal year	5,650.00

4 E.

DEFENSES OF NEW YORK—AT EASTERN ENTRANCE TO HARBOR, ON ISLANDS IN HARBOR, ON STATEN ISLAND, AND AT SOUTHERN ENTRANCE TO HARBOR, ON LONG ISLAND AND SANDY HOOK.

Officer in charge at eastern entrance to harbor, on islands in harbor, and on Staten Island, Maj. Henry M. Adams, Corps of Engineers; assistants, Lieut. Robert R. Raymond, Corps of Engineers, and Lieut. James F. McIndoe, Corps of Engineers, the latter since April 11, 1898; torpedo defenses at eastern entrance to harbor in charge of Maj. John G. D. Knight, Corps of Engineers, since April 6, 1898; officer in charge of defenses on Long Island and at Sandy Hook, Brig. Gen. William Ludlow (now Maj. Gen.), U. S. Volunteers, Lieutenant-Colonel, Corps of Engineers, until April 21, 1898; after that date, Maj. Henry M. Adams, Corps of Engineers: assistants, Lieut. Robert McGregor, Corps of Engineers, and Lieut. Edwin R. Stuart, Corps of Engineers, the latter since April 16, 1898; Division Engineer, Brig. Gen. George L. Gillespie, U. S. Volunteers, Colonel, Corps of Engineers.

AT EASTERN ENTRANCE TO HARBOR.

Mortar battery for sixteen 12-inch mortars.—July 1, 1897, the mortar battery was completed and mortars mounted; the installation of electric plant for lighting the battery had been begun.

During the past fiscal year the electric lighting appliances were completed.

Under an allotment from the appropriation for "National Defense," an earth parapet has been constructed in front of the practice battery (one 8-inch converted rifle and one 15-inch smooth-bore gun), and magazines have been built. It is designed to alter the 15-inch carriage for one 8-inch breech-loading rifle as soon as the latter gun is delivered.

Preservation and repair of fortifications.—Under an allotment for improving the drainage of the mortar battery, and for introducing a water supply to each pit, the catch basins and gratings at the gallery openings have been enlarged, and the north magazine floor has been graded. The water pipes are being laid to the pits.

Money statements.

GUN AND MORTAR BATTERIES.

July 1, 1897, balance unexpended		$8,196.70
December 21, 1897, amount transferred to another work	$1,297.29	
June 30, 1898, amount expended during fiscal year	6,899.41	
		8,196.70

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

April 18, 1898, amount allotted for construction of parapet	$2,500.00	
April 27, 1898, amount allotted for one emplacement for 8-inch B. L. rifle	3,000.00	
		$5,500.00
June 30, 1898, amount expended during fiscal year		2,941.74
July 1, 1898, balance unexpended		2,558.26
July 1, 1898, outstanding liabilities		1,042.65
July 1, 1898, balance available		1,515.61

PRESERVATION AND REPAIR OF FORTIFICATIONS.

December 9, 1897, amount allotted for purchase of electric supplies	$61.58	
March 26, 1898, amount allotted for correction of defective drainage, etc	2 500.00	
		$2,561.58
June 30, 1898, amount expended during fiscal year		245.40
July 1, 1898, balance unexpended		2,316.18
July 1, 1898, outstanding liabilities		156.13
July 1, 1898, balance available		2,160.05

On the northern side of entrance.—These works consist of an old stone fort and outlying batteries, with modern battery for two 10-inch breech-loading rifles and one position for 12-inch breech-loading rifle, on disappearing carriages.

At the beginning of the past fiscal year the platforms for the 10-inch guns were ready; the parapet, magazines, and appliances for handling ammunition were incomplete. Construction on the 12-inch emplacement had not been begun.

Two emplacements for 10-inch rifles.—At this battery during the past fiscal year 2,864 cubic yards of concrete were placed in parapet and magazines, completing the concrete work; the earth slopes were filled, graded, and sodded. Lifts, trolleys, cranes, and appliances for handling ammunition have been placed. The battery is completed except minor repairs to the ammunition lifts and the introduction of water supply, which is being made. No method of lighting the magazines is yet provided. The guns and carriages are mounted, and the battery was turned over to the commanding officer May 5, 1897.

Emplacement for 12-inch rifle.—At this emplacement the concrete work of the parapet, platform, and magazines, and the earthwork of the parapet are completed. The cranes and trolley for handling ammunition have been set up. The platform is ready for mounting the gun.

To complete the emplacement there remains the partial sodding of earthwork, grading rear slope, removal of a small amount of old masonry, the placing of ammunition hoist, and the introduction of water supply. No arrangement for lighting the magazines is yet adopted.

Preservation and repair of fortifications.—The caving bank in front of the 10-inch battery has been partly protected by building a riprap wall in front of it, at and near high-water mark. The gallery of the second-tier casemate quarters was repaired and a platform for an 8-inch converted rifle was built.

Sea wall at Fort Schuyler, N. Y.—The protection of the sea wall by placing riprap along its base was continued until the available funds were exhausted.

Money statements.

GUN AND MORTAR BATTERIES.

July 1, 1897, balance unexpended	$77,123.18	
June 9, 1898, amount allotted for moving 12-inch gun and carriage	1,500.00	
June 28, 1898, amount allotted for water supply	75.00	
		$78,698.18
June 30, 1898, amount expended during fiscal year		73,611.08
July 1, 1898, balance unexpended		5,087.10
July 1, 1898, outstanding liabilities		3,331.26
July 1, 1898, balance available		1,755.84

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1897, balance unexpended	$1,904.10	
January 8, 1898, amount allotted for repairs to gallery	150.00	
March 16, 1898, amount allotted for platform for 8-inch converted rifle	200.00	
		$2,254.10
June 30, 1898, amount expended during fiscal year		2,140.55
July 1, 1898, balance unexpended		113.55
July 1, 1898, outstanding liabilities		112.50
July 1, 1898, balance available		1.05

SEA WALLS AND EMBANKMENTS.

July 1, 1897, balance unexpended	$884.00
June 30, 1898, amount expended during fiscal year	884.00

On the southern side of entrance.—July 1, 1897, emplacements Nos. 1, 2, and 3 of the gun battery were nearly completed; work on emplacement No. 6 and on the rebuilding of eight platforms of the mortar battery had been just begun.

Gun battery.—During the past fiscal year emplacements Nos. 1, 2, and 3 have been completed and the parapet covered with a waterproofing of asphalt.

Emplacement No. 6.—The concrete work is finished and the earthwork nearly finished. Ammunition lift, trolley, and cranes for handling ammunition are in place. Water pipes have been laid to these emplacements.

Work on the two emplacements for rapid-fire guns was begun in April, 1898. The platforms are nearly completed and the magazine walls are built up to the platform level.

Work of excavating the sites for emplacements Nos. 4 and 5 was begun June 15, 1898.

Mortar battery.—The eight platforms for modern 12-inch mortars have been built, and mortars and carriages are mounted. There remains the completion of grading of the pit floors and of building side walls in the pits and the introduction of water supply.

Preservation and repair of fortifications.—During the fiscal year the sea wall was repaired by placing 1,493 cubic yards of riprap along its base. Repairs were made to the engineer wharf and buildings; the sewer under the stone fort was pumped out and cleaned; pipes and fittings were placed, and water supply introduced at the several emplacements of the gun battery.

Money statements.

GUN AND MORTAR BATTERIES.

July 1, 1897, balance unexpended	$59,631.13	
December 21, 1897, amount allotted for two emplacements for R.F. guns	9,000.00	
May 6, 1898, amount allotted for asphalt waterproofing emplacements	5,600.00	
June 4, 1898, amount allotted for two 12-inch emplacements	100,000.00	
June 15, 1898, amount allotted for completion of eight mortar platforms	3,000.00	
		$177,231.13
June 30, 1898, amount expended during fiscal year		59,130.89
July 1, 1898, balance unexpended		118,100.24
July 1, 1898, outstanding liabilities		20,013.26
July 1, 1898, balance available		98,086.98

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1897, balance unexpended	$2,000.00	
January 8, 1898, amount allotted	1,000.00	
May 18, 1898, amount allotted	550.00	
		$3,550.00
June 30, 1898, amount expended during fiscal year		3,352.48
July 1, 1898, balance unexpended		197.52
July 1, 1898, outstanding liabilities		157.69
July 1, 1898, balance available		39.83

AT SOUTHERN ENTRANCE TO HARBOR.

Defenses on Long Island.—These consist of a stone fort and outlying batteries with modern defenses.

July 1, 1897, emplacements Nos. 6 and 7 of the 10-inch battery were completed, and emplacement No. 5 was complete except setting the base rings and ammunition lifts. Work on emplacement No. 4 had just been begun. Construction of other emplacements had not been begun.

During the past fiscal year the following work has been done:

Ten-inch battery.—Emplacements Nos. 4 and 5 have been completed, and with Nos. 6 and 7 turned over to the commanding officer. In these emplacements guns are mounted and in readiness for service. Under an allotment from the appropriation for "National Defense," work upon emplacements Nos 3, 2, and 1 was begun; the platforms for Nos. 3 and 2 are ready for carriages, and at No. 1 excavation is in progress.

Twelve-inch positions.—Under an allotment from the appropriation for "National Defense," work on construction of two emplacements for 12-inch breech-loading rifles, barbette, on nondisappearing carriages has been begun. Excavation for foundations is in progress, and laying of concrete commenced.

Under allotment from the appropriation for "Gun and Mortar Batteries," the construction of two emplacements for 12-inch breech-loading rifles on disappearing carriages, model 1897, was authorized June 27, 1898. Detail plans for these emplacements have been submitted and approved.

Rapid-fire guns.—Construction of two emplacements for 4.7-inch rapid-fire guns was authorized, under allotment from appropriation for "National Defense." Plans for conversion of platforms 7 and 8 of 15-inch gun battery (water battery) to meet the requirements for rapid-fire guns were approved, and the emplacements were completed and guns mounted May 17, 1898.

Twelve-inch breech-loading mortars.—June 27, 1898, an allottment from appropriation for "Gun and Mortar Batteries," was made for construction of a battery of eight 12-inch mortars. Plans for the work are being prepared.

The following table shows the dates when it is estimated the platforms of these several emplacements will be ready to receive armament, and when the emplacements may be wholly completed:

	Platforms ready for armament.	Emplacement to be completed.
10-inch battery:		
Nos. 7, 6, 5, and 4	.....	Already.
No. 3	Now	Aug. 1, 1898
No. 2	Now	Sept. 1, 1898
No. 1	July 31, 1898	Sept. 30, 1898
12-inch positions:		
No. 1	July 15, 1898	Nov. 15, 1898
No. 2	Aug. 1, 1898	Sept. 30, 1898
Nos. 3 and 4	Nov. 30, 1898	June 30, 1899
Mortar battery: 8 positions	Nov. 30, 1898	June 30, 1899

Preservation and repair of fortifications.—During the past year the sea wall in front of the 10-inch battery was repaired, and slopes of the water battery were repaired and sodded.

Platforms 3, 4, 5, and 6 of the water battery were altered for 8-inch converted rifles, and carriages and guns were mounted.

Money statements.

GUN AND MORTAR BATTERIES.

July 1, 1897, balance unexpended		$57,132.42
June 27, 1898, amounts allotted		200,000.00
		257,132.42
June 30, 1898, amount expended during fiscal year	$53,747.95	
Restored to appropriation	3,000.00	
		56,747.95
July 1, 1898, balance unexpended		200,384.47
July 1, 1898, outstanding liabilities		349.38
July 1, 1898, balance available		200,035.09

NATIONAL DEFENSE, ACT MARCH 9, 1898.

March 18, 1898, amount allotted for three 10-inch gun emplacements	$75,000.00	
June 10 1898, amount allotted for three 10-inch gun emplacements	25,000.00	
		$100,000.00
April 6, 1898, amount allotted for two 4.7-inch R. F. gun emplacements		6,000.00
April 25, 1898, amount allotted for two emplacements for 12-inch B. L. guns, on barbette	40,000.00	
June 10, 1898, amount allotted for two emplacements for 12-inch B. L. guns, on barbette	40,000.00	
		80,000.00
		186,000.00
June 30, 1898, amount expended during fiscal year		24,880.46
July 1, 1898, balance unexpended		161,119.54
July 1, 1898, outstanding liabilities		13,231.58
July 1, 1898, balance available		147,887.96

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1898, balance unexpended		$2,213.68
June 30, 1898, amount expended during fiscal year	$1,494.66	
Transferred to another work	200.00	
		1,694.66
July 1, 1898, balance unexpended		519.02
July 1, 1898, outstanding liabilities		338.85
July 1, 1898, balance available		180.17

Defenses on Staten Island.—These fortifications consist of two old casemate stone forts and outlying batteries, with modern defenses.

July 1, 1897, a mining casemate and torpedo storage building and tank had been constructed; a 5-gun battery for 8-inch rifles had been completed; the two batteries (four emplacements) for 10-inch guns had been finished except the ammunition lifts and minor details.

During the past fiscal year the following work has been done.

Mining casemate and torpedo building and tank.—An oil engine has been installed in the mining casemate, water supply has been intro-

duced, and a passage has been opened from the casemate to the channel. In the storage building a bridge crane has been mounted and used for handling torpedo cases and apparatus; a storage room 29 by 13 feet and 10 feet high has been partitioned off in the east corner of the building, fitted with shelves, benches, and table for electric and other appliances requiring careful handling; the torpedoes, anchors, junction boxes, etc., have been cleaned and painted. In the cable tank a movable hoist for handling cable drums has been mounted and used.

Five-gun battery.—Five sets of hand rails have been placed at the stairs to the gun platforms, and the superior concrete slope has been painted.

Two 2-gun batteries for 10-inch guns.—These have been provided with ammunition lifts, trolleys, and cranes; magazine doors have been hung; stairs, hand rails, and ladders have been set; the superior slopes have been painted; electric lights have been placed in the magazines; the grading of roadways and sodding of slopes has been finished; and four booths have been built to cover telephones, one at each emplacement.

These batteries are completed. They were turned over to the commanding officer December 18, 1897.

Twelve-inch emplacements.—Under an allotment from the appropriation for "National Defense," construction of two emplacements for 12-inch breech-loading rifles, to the west of the 10-inch gun batteries, was begun in March, 1898. Excavation has been nearly completed, platforms are ready to receive armament, and parapet and walls are built to level of the magazine ceilings.

Under allotment from the appropriation for "Gun and Mortar Batteries," construction of two emplacements for 12-inch guns on disappearing carriages, low fire, model 1896, was begun in June, 1898, the site being north of the south flank of Battery Hudson. At the close of the fiscal year excavation for platform of emplacement No. 1 was under way and appliances for making concrete were being set up.

Rapid-fire guns.—Under an allotment of $6,000 from the appropriation for "National Defense," work was begun in April upon construction of two emplacements for 4.7-inch rapid-fire guns at two sites, designed to protect the mine fields. The platforms were completed and guns mounted by May 3, 1898. At the close of the fiscal year the emplacements were completed, except one magazine door and the coloring of the superior concrete slope.

Two emplacements for 8-inch breech-loading rifles on modified 15-inch gun carriages.—Under allotment from appropriation for "National Defense," the mounting of two of these guns was authorized. The platforms and magazines of the old battery required no alteration. Up to the close of the fiscal year one of the carriages has been altered and was nearly completed; the guns had not been received.

Submarine-mine defense of the Narrows.—Under allotments from the appropriation for "National Defense," the planting of mines was begun in April and continued until June 11, since which time work has been confined to keeping the groups of mines in repair and working order.

Temporary battery, Staten Island.—The construction of this battery, having emplacements for three 8-inch converted rifles, was authorized, and work was begun in May, 1898, under an allotment from the appropriation for "National Defense." At the close of the fiscal year the platforms, sand parapet, and magazines had been completed and the battery was in readiness for armament.

Electric-lighting plant and artillery fire control.—During the year the electric-lighting plant, already purchased, was installed in two casemates of an old work and the two batteries for 10-inch guns were connected and lighted. Four range-finder houses have been built.

The lighting plant and range-finder houses were turned over to the Board on Regulation of Sea-coast Artillery Fire November 12, 1897.

Preservation and repair of fortifications.—Under various allotments the following work was done during the past fiscal year:

Minor repairs were made to several of the old works.

The sea wall north of the north wharf was repaired and extended.

Three manholes were repaired in the sewer in the long slope east of the old fort.

An iron fence was built on the south side of Richmond avenue.

The cable-tank building and hoisting apparatus were painted; the cleaning and storing of torpedo material was completed.

In one of the outlying batteries pintle plates were set on platforms for 15-inch guns, and five of the 15-inch gun platforms were altered to adapt them to carriages for 8-inch converted rifles.

The gutters in rear of guns were cleaned.

Sites for fortifications and seacoast defenses.—A site known as tract No. 1 of the King property, with a narrow strip extending to tide water, was purchased at a cost of $60,000.

The deed, dated March 11, 1898, was duly executed and recorded.

Money statements.

GUN AND MORTAR BATTERIES.

July 1, 1897, balance unexpended	$75,643.43	
June 30, 1898, amount withdrawn during fiscal year	51,774.33	
	23,869.10	
June 18, 1898, amount allotted for two emplacements for 12-inch guns	100,000.00	
		$123,869.10
June 30, 1898, amount expended during fiscal year		19,661.53
July 1, 1898, balance unexpended		104,207.57
July 1, 1898, outstanding liabilities		2,443.70
July 1, 1898, balance available		101,763.87

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

Gun emplacements.

March 18 and 23, 1898, amounts allotted for two 12-inch gun emplacements	$100,000.00	
April 6, 1898, amount allotted for mounting two rapid-fire guns	6,000.00	
April 27, 1898, amount allotted for two emplacements for 8-inch B. L. rifles	6,000.00	
		$112,000.00
June 30, 1898, amount expended during fiscal year		33,427.03
July 1, 1898, balance unexpended		78,572.97
July 1, 1898, outstanding liabilities		16,748.77
July 1, 1898, balance available		61,824.20

Temporary battery, Staten Island.

May 11, 1898, amount allotted	$5,000.00
June 30, 1898, amount expended during fiscal year	3,953.64
July 1, 1898, balance unexpended	1,046.36
July 1, 1898, outstanding liabilities	145.89
July 1, 1898, balance available	900.47

Submarine-mine defense of the Narrows.

March 18, 1898, amount allotted	$1,250.00	
April 4, 1898, amount allotted	17,000.00	
April 8, 1898, amount allotted	5,000.00	
		$23,250.00
June 30, 1898, amount expended during fiscal year		8,836.83
July 1, 1898, balance unexpended		14,413.17
July 1, 1898, outstanding liabilities		2,268.82
July 1, 1898, balance available		12,144.35

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1897, balance unexpended	$6,146.12	
July 31, 1897, amount withdrawn	5,000.00	
		$1,146.12
June 30, 1898, amount allotted during fiscal year		4,945.00
		6,091.12
June 30, 1898, amount expended during fiscal year		5,617.35
July 1, 1898, balance unexpended		473.77
July 1, 1898, outstanding liabilities		183.79
July 1, 1898, balance available		289.98

TORPEDOES FOR HARBOR DEFENSE.

July 1, 1897, balance unexpended	$1,350.76	
July 24, 1897, amount allotted	1,100.00	
June 10, 1898, amount allotted	4,000.00	
		$6,450.76
June 30, 1898, amount expended during fiscal year		2,450.76
July 1, 1898, balance unexpended		4,000.00

SITES FOR FORTIFICATIONS AND SEACOAST DEFENSES.

January 4, 1898, amount allotted	$60,000.00	
March 17, 1898, amount allotted	3.90	
		$60,003.90
June 30, 1898, amount expended during fiscal year		60,003.90

Defenses at Sandy Hook.—July 1, 1897, Mortar Battery No. 1 and Gun-lift Battery No. 1 had been completed; a mining casemate and storage building had been built; a cable tank had been built, but not covered nor supplied with appliances for handling drums of cable; one 10-inch disappearing gun battery, two positions, was complete except ammunition lifts, and a 3-gun battery for 10-inch guns was under construction by contract. A plan for construction of two emplacements for 12-inch disappearing guns, model 1896, had been approved; work had not been begun. No work had been done on the emplacement for one 5-inch rapid-fire gun.

During the past fiscal year the following work was done:

Mortar Battery No. 1.—Eight of the platforms were dismantled and provided with index rings of the new pattern. The rings have been fitted, and the grading up of the concrete floor is in progress.

Gun-lift Battery No. 1.—A condenser for disposing of exhaust steam was installed; two range-finder piers for portable instruments were built.

Ten-inch Battery No. 1.—Two emplacements on site originally proposed for a second gun-lift battery. Ammunition lifts were put up, electric lighting completed, and the completed battery was turned over to the commanding officer.

Ten-inch Battery No. 2.—Three emplacements adopted in lieu of one of the originally proposed two iron casemates. This battery was constructed by contract with Frank W. Molloy. The contract was closed February 28, 1898, when the work was completed except part of the

handrail and pavement. It is now completed, but lacks electric lighting, which was not included in the contract.

Twelve-inch Battery No. 2.—Two emplacements in continuation of 10-inch Battery No. 2. Work on this battery was begun September 1, 1897, since which time 9,732 cubic yards of concrete have been placed. Both platforms are now ready for armament, the magazines have been built, and the work is generally finished up to within 6 feet of the crest level. It is expected to complete it by October 1, 1898.

Twelve-inch Battery No. 3.—Two emplacements for 12-inch breech-loading rifles. Work is recently begun under an allotment from the appropriation for "National defense." It is expected that both platforms will be ready for armament by August, and with fair weather the battery may be completed by January 1, 1899.

Five-inch rapid-fire gun.—Work on this emplacement was begun September 5, 1897. It was suspended to await delivery of the mount, parts of which were to be built into the concrete. The emplacement was completed April 21, 1898.

Six-inch rapid-fire gun.—Under an allotment from the appropriation for "National Defense" a railroad track to the site has been built, and plans for the battery have been approved. Construction is not yet begun.

Pneumatic Gun Battery.—This is a battery for three pneumatic guns, two 15-inch and one 8-inch, built by the Pneumatic Torpedo and Construction Company.

A contract has been made for building a sand parapet, consisting of 30,000 cubic yards of sand, with sandbag retaining walls, and for building two timber magazines. The contract is nearly completed, about 3,000 yards of sand remaining to be placed.

Mining casemate and torpedoes.—During the year two storage tanks for submarine cables were constructed by remodeling two cisterns in the old stone fort.

Submarine mines to be operated from this station have been planted, two searchlights, with independent operating plants, have been installed, and one 5-inch siege rifle, one 7-inch siege howitzer, and one 4.7-inch rapid-fire gun have been mounted in temporary emplacements.

Preservation and repair of fortifications.—At the mortar battery the doors and ironwork were painted and the slopes kept in repair. The electric wiring was removed from wooden conduits and replaced in iron pipes.

At the gun-lift battery the machinery was cared for and kept in order and the tubing of the boilers was renewed.

Shore protection, Sandy Hook, New Jersey.—During the early part of 1897 a violent storm broke through the sand spit of Sandy Hook, about 4 miles south of its northern point, closing up the channel of Shrewsbury River and threatening to destroy the only land communication with the fortifications at Sandy Hook. By act of Congress approved March 3, 1897, $75,000 was appropriated "for construction of a riprap wall for protection of the eastern beach of United States lands at Sandy Hook, New Jersey."

After advertising for proposals a contract was entered into with Frank W. McNeal, under date of October 15, 1897, approved by the Chief of Engineers October 25, 1897, and expiring April 14, 1898, for building a riprap wall to close the breach. Amount of contract, 47,500 tons of riprap, at $1.19 per ton, delivered and placed. Work under this contract was begun November 19, 1897, and the contract was completed June 1, 1898, with delivery of 47,500 tons of riprap. To complete this work, for which the amount of the contract was not sufficient, an open-

market agreement with the same person was made for further delivery of 12,000 tons of riprap. This work is in progress and will be completed during July, 1898. The amount of stone received under contract was 47,500 tons; under open-market purchase up to July 1, 1898, 9,665 tons; total, 57,165 tons.

Abstract of proposals for the delivery of broken stone and cement for concrete, received in response to advertisement dated February 21, 1898, and opened March 23, 1898, by Lieut. Col. William Ludlow, Corps of Engineers.

No.	Name of bidder.	Broken stone (12,000 cubic yards).					
		Trap.		Limestone.		Granite.	
		Per cubic yard.	Amount.	Per cubic yard.	Amount.	Per cubic yard.	Amount.
1	Daniel J. Donovan					$1.39	$16,680.00
2	Wm. Turner	$1.28	$15,360.00				
3	Saml. E. Bouker			$1.09	$13,080.00		
4	Atlas Cement Co						
5	Jacob E. Conklin	1.04	12,480.00				
6	The Standard Silica Cement Co						
7	Chas. Frey, jr	1.50	18,000.00	1.20	14,400.00		
8	Walter C. Butler			1.14½	13,740.00		
9	Lawrenceville Cement Co						
10	New York and Rosendale Cement Co						
11	Union Akron Cement Co						
12	Charles W. Hall						
13	Fiske Brothers Refining Co						

No.	Name of bidder.	Rosendale cement (18,000 barrels).		American Portland cement (10,000 barrels).		Remarks.
		Per barrel.	Amount.	Per barrel.	Amount.	
1	Daniel J. Donovan					
2	Wm. Turner					
3	Samuel E. Bouker					
4	Atlas Cement Co			$1.94	$19,400.00	Atlas brand.
5	Jacob E. Conklin					Lowest bid for stone (trap).
6	The Standard Silica Cement Co			1.80	18,000.00	Champion brand.
7	Chas. Frey, jr					
8	Walter C. Butler	$0.66 8/10	$11,988.00			Old Newark; lowest bid for Rosendale.
9	Lawrenceville Cement Co	.80	14,400.00			
10	New York and Rosendale Cement Co	.69 2/3	12,580.00			
11	Union Akron Cement Co	1.05	18,900.00			
12	Charles W. Hall			1.74	17,400.00	Steel brand; lowest bid for Portland.
13	Fiske Brothers Refining Co			1.94 8/10	19,490.00	Saylor's brand.

Abstract of proposals for constructing riprap wall at Sandy Hook, New Jersey, received in response to advertisement dated July 25, 1897, and opened August 25, 1897, by Lieut. Col. William Ludlow, Corps of Engineers.

No.	Names of bidders.	Riprap stone in place, 47,500 tons of 2,000 pounds each.		Remarks.
		Price per ton.	Amount.	
1	Frank W. McNeal	$1.19	$56,525	Lowest bid.
2	Patrick H. Flynn	2.62	124,450	
3	S. & E. S. Belden	1.23	58,425	
4	Andrew A. Bouker	1.73	82,175	
5	P. Sanford Ross	1.79	85,025	
6	John J. Shipman	2.00	95,000	Harlem River stone, $2.10 per ton.
7	Quinn & Kerbaugh	1.92	91,200	
8	The Degnan-McLean Construction Co	1.85	87,875	
9	Humphrey Toomey	1.24	58,900	

Contracts in force.

With Walter C. Butler, for Rosendale cement, dated April 5, 1898, approved by the Chief of Engineers April 23, 1898. Deliveries to begin April 20 and to be completed August 1, 1898.

With Jacob E. Conklin, for broken stone, dated April 5, 1898, approved by the Chief of Engineers April 23, 1898. Deliveries to begin April 20 and to be completed August 1, 1898.

With Frank W. McNeal, for riprap stone in place, dated October 15, 1897, approved by the Chief of Engineers October 25, 1897. Completed June 1, 1898.

Money statements.

GUN AND MORTAR BATTERIES.

July 1, 1897, balance unexpended		$133,963.60
January 8, 1898, amount allotted	$2,000.00	
February 10, 1898, amount allotted	3,000.00	
June 17, 1898, amount allotted	3,500.00	
June 18, 1898, amount allotted	483.16	
June 23, 1898, amount allotted	350.00	
		9,333.16
		143,296.76
June 30, 1898, amount expended during fiscal year	68,477.65	
Restored to appropriation	10,000.00	
		78,477.65
July 1, 1898, balance unexpended		64,819.11
July 1, 1898, outstanding liabilities	17,171.60	
July 1, 1898, amount covered by uncompleted contracts	14,408.13	
		31,579.73
July 1, 1898, balance available		33,239.38

Contract work.

July 1, 1897, balance unexpended		$88,151.54
June 30, 1898, amount expended during fiscal year	$68,305.52	
Restored to appropriation	19,846.02	
		88,151.54

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1897, balance unexpended		$3,710.97
Transferred from another work	$200.00	
March 7, 1898, amount allotted	1,000.00	
June 9, 1898, amount allotted	1,218.00	
		2,418.00
		6,128.97
June 30, 1898, amount expended during fiscal year		4,260.75
July 1, 1898, balance unexpended		1,868.22
July 1, 1898, outstanding liabilities		739.33
July 1, 1898, balance available		1,128.89

TORPEDOES FOR HARBOR DEFENSE.

July 1, 1897, balance unexpended	$1,541.45
June 10, 1898, amount allotted	1,200.00
	2,741.45
June 30, 1898, amount expended during fiscal year	1,266.07
July 1, 1898, balance unexpended and available	1,475.38

SEA WALL, NORTH SHORE OF SANDY HOOK, NEW JERSEY.

July 1, 1897, balance unexpended	$2,201.97
July 1, 1898, balance unexpended and available	2,201.97

RIPRAP WALL, EAST SHORE OF SANDY HOOK, NEW JERSEY.

July 1, 1897, balance unexpended	$75,000.00
June 30, 1898, amount expended during fiscal year	54,011.06
July 1, 1898, balance unexpended	20,988.94
July 1, 1898, outstanding liabilities	18,606.35
July 1, 1898, balance available	2,382.59

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

Batteries, etc.

March 18, 1898, amount allotted for two 12-inch gun emplacements	$50,000.00	
March 24, 1898, amount allotted for two 12-inch gun emplacements	30,000.00	
		$80,000.00
April 9, 1898, amount allotted for protection of dynamite guns	10,000.00	
May 23, 1898, amount allotted for protection of dynamite guns	2,000.00	
		12,000.00
April 25, 1898, amount allotted for two 6-inch rapid-fire gun emplacements		16,000.00
May 11, 1898, amount allotted for range-finder station		200.00
		108,200.00
June 30, 1898, amount expended during fiscal year		6,426.73
July 1, 1898, balance unexpended		101,773.27
July 1, 1898, outstanding liabilities		13,643.09
July 1, 1898, balance available		88,130.18

Torpedo defense.

March 18, 1898, amount allotted for southern entrance New York Harbor	$1,000.00
April 4, 1898, amount allotted for southern entrance New York Harbor	9,000 00
April 23, 1898, amount allotted for southern entrance New York Harbor	20,000.00
	30,000.00
June 30, 1898, amount expended during fiscal year	17,280.05
July 1, 1898, balance unexpended	12.719.95
July 1, 1898, outstanding liabilities	3,616.12
July 1, 1898, balance available	9,103,83

TORPEDO DEFENSES AT EASTERN ENTRANCE TO HARBOR.

All the necessary plant was stored at Willets Point, except 208 No. 32 buoyant mine cases and their 1,000-pound anchors, which were stored at Fort Schuyler. Of these, 105 cases and their anchors were transferred for use at New London, Conn.

By telegram of April 22, 1898, the Chief of Engineers directed mines to be planted.

A sufficient defense, it was thought, could be had from three lines of mines across the main channel, one of these lines to extend across the greater part of the waterway, and one skirmish line in advance of the mine field. Until final complete closure of the entrance, it was determined not to plant the skirmish line nor such mines of the three lines as were to be located in a buoyed channel 500 feet wide through the western edge of the mine field.

The first line of mines, as planted, comprised 33 mines; the second, 12; the third, 14 mines. Six mines of the first line, not planted, were to be located in the buoyed channel, 9 mines of the second line, and 7 of the third line.

The mine defense was carried on under the immediate supervision of Capt. W. C. Langfitt, Corps of Engineers, from April 16, 1898, to May 26, 1898, when, on account of his being detached from duty at the post, he was relieved by Capt. S. W. Roessler, Corps of Engineers, who remained in immediate charge at the close of the year.

By April 27 the casemate was fitted up and 18 loaded mines tested; April 29, 21 more were tested.

May 1, three triple groups planted; May 2, four triple groups planted, and May 3, four more were planted, thus completing the first line of 33 torpedoes.

The second and third lines were completed May 12, several days stormy weather intervening. The same night, and on all nights thereafter, one or both men of a detail of one noncommissioned officer and one private slept in the mining casemate.

As a whole, the mines remained in good condition until June 16, 1898; then repairs at different times of three triple groups were found necessary. The tests of July 1, 1898, showed all triple groups but two in good condition, and these two with excessive leakage.

The sum of $1,476 was expended for 8,200 pounds of 75 per cent dynamite.

Regulations for the navigation of the eastern entrance were printed and widely disseminated May 9, 1898, as per copy inclosed. A patrol boat, manned by the United States Naval Reserves, was occasionally on duty at the mine field, but much of the time none was present.

Trouble was experienced by sailing vessels passing through the field and fouling mooring ropes, thereby disarranging and entangling cables. It became evident that all craft, whether steam or sailing, drawing 3 feet or more should be required to follow the channel buoyed by the light-house department. The damage due to sailing vessels arises mainly when they tack from side to side of the mine field, while at the same time making leeway along the field.

REGULATIONS FOR THE NAVIGATION OF THE EASTERN ENTRANCE TO NEW YORK HARBOR IN TIME OF WAR.

Submarine mines having been placed in position in connection with the defenses of the eastern entrance to New York Harbor, the following regulations for the safe navigation of the river by friendly vessels and for the protection of the defenses are hereby established by authority of the Secretary of War:

1. No vessel will be allowed to pass through the waters between Fort Schuyler and Willets Point between the hours of 8 p. m. and 4 a. m. During this interval vessels must not approach within 3 miles of the forts.

2. Patrol boats will be stationed above and below the defenses. These boats are authorized to stop vessels to inquire into their character, or to instruct them how to pass through the mine fields. The orders of the patrol boats must be strictly obeyed.

3. Sailing vessels, and all small vessels drawing 3 feet or less, can pass safely through any part of the channels during the daytime.

4. Steam vessels must pass at slow speed through a special channel, which will be marked by buoys.

5. No vessel will be allowed to anchor between Stepping Stones Light and Cryders Point without special authority.

6. Vessels are warned that, if they disregard these regulations, they will expose themselves to serious damage, and will be liable to be fired on by the batteries.

JOHN G. D. KNIGHT,
Major, Corps of Engineers, U. S. A.

WILLETS POINT, N. Y., *May 9, 1898.*

4 F.

DEFENSES OF THE DELAWARE RIVER.

Officer in charge, Lieut. Col. Charles W. Raymond, Corps of Engineers, with Maj. Spencer Cosby, U. S. Volunteers, Lieutenant, Corps of Engineers, and Lieut. Sherwood A. Cheney, Corps of Engineers, under his immediate orders, the latter from September 30, 1897, to April 10, 1898.

Battery for three 10-inch and three 12-inch disappearing guns.—The project under which this battery was constructed, and a detailed account of the progress of the work, and of the battery as constructed, are contained in the Annual Report of the Chief of Engineers for 1897, pages 628 to 636.

During the fiscal year the permanent roadway leading from the wharf to and along the rear of the battery was completed. The electric system for operating the ammunition hoists and for lighting the battery, the ammunition hoists themselves, the cranes in rear of the loading platforms, and the overhead trolley systems for the service of ammunition were installed and placed in full working order. All have been frequently and successfully tested and operated, and care has been taken to keep them in good condition. Other items of work about the battery proper that have been done during the year are the erecting of the stairways and guard rails in rear of the first two emplacements, the painting of all the iron work and of the walls of the magazines and galleries throughout the battery, and the coloring of the superior slope green.

Excavation for the earthen parados, which is to protect the battery from reverse fire, began on July 15, 1897, but was discontinued from August 19 to December 11, 1897, to enable the derrick and engine used on the work to be transferred temporarily to another work. Work was resumed on December 11, 1897, and has continued ever since with frequent interruptions caused by the weather and by the large amount of water standing at times in the excavated ditch. The topsoil is removed to a depth of several feet and placed in the parados by means of wheeled scrapers, eight of which are employed on the work. The excavation is then continued with a grapple-bucket, operated by a derrick. On June 30, 1898, 33,984 cubic yards of earth and sand had been placed in the parados, out of a total estimated quantity of 42,000 cubic yards. In addition two latrines had been built in the side of the parados toward the battery in rear of emplacements Nos. 2 and 5. The total cost of the parados to June 30, 1898, was $9,862.28.

Telephone booths were erected on the loading platform of each of the six emplacements. The tops of the traverses and the loading platforms were given a coating of linseed oil mixed with naphtha to prevent the leakage of water through them into the magazines and passages below. Sufficient time has not yet elapsed to determine the measure of success of this experiment.

During July and August, 1897, the entire construction plant was taken down and transferred to the work on the Delaware shore. The site occupied by the plant was cleared and graded. Rows of trees were planted as a screen in front of the battery along the sea wall, the road, and the boundary fence. The old buildings in rear of the battery, used as a carpenter shop, stable, and granary, were moved back to sites along the road leading to the National cemetery and placed on suitable foundations and repaired. They were then turned over to the gar-

rison for its use. The exterior slope of the battery was sowed with grass seed, and the gullies washed in it by storms were repaired.

At the close of the preceding fiscal year the three emplacements for 12-inch guns on disappearing carriages were reported ready for their armament. Two 12-inch rifles were delivered on the wharf on October 10, 1897, and were moved to positions in rear of emplacements Nos. 1 and 2. On December 16, 1897, the bedplate of disappearing carriage No. 1 was received. It was taken to emplacement No. 1 and set in place. The remainder of the carriage was not received until four months later. An inclined trestle of wood was erected, leading from the ground to the loading platform. It was placed in turn in rear of each emplacement and used to raise the guns and the various parts of the carriages to the platforms.

Twelve-inch disappearing carriage No. 2 arrived on eight cars at the Government wharf on February 11, 1898, and its unloading was completed by the contractors three days later. The parts of the carriage were moved as rapidly as possible to emplacement No. 2, 1,800 feet from the wharf, and the setting of the bedplate and the assembling of the other parts were proceeded with at once. Though interfered with by stormy weather, the mounting of the carriage and gun was completed on March 7. The work of moving and mounting was done by the engineer force. A derrick with an 80-foot mast, capable of handling loads up to 5 tons, was erected in the rear of the platform; heavy shear poles of 12-inch by 12-inch timber were set up over the carriage. The setting of the bedplate was done with great care. It was first bolted together and leveled up about 18 inches above the leveling wedges. These were then set by measurement from the bottom of the bedplate. This preliminary leveling was necessary, as the bottom of the bedplate is not a turned surface, but varies in thickness as much as three-sixteenths of an inch, while the rise of the wedges is only about one-sixteenth of an inch for the full drive of 5 inches. The bedplate was then lowered on the wedges, carefully leveled, and bolted down. The leveling was done with a Y-level accurately adjusted, and with a short rod and target plumbed in two directions by spirit levels. Four points on the roller path, 90° apart, were first brought to the same level by means of the wedges and the foundation bolts. Then levels were taken on the roller path opposite each bolt and each point was brought to the same level and each nut was brought to a firm bearing with a long wrench worked by five men. After all the nuts had been thus tightened the levels were twice checked with the Y-level, and finally were very carefully checked with a machinist's level and straightedge. The openings under the bedplate were filled with Portland cement mortar, mixed in the proportion of 1½ cement to 1 sand, and made just thick enough to run freely through funnels. The small parts of the carriage were lifted to the platform by the derrick. The heavy parts and the gun were each placed on a cradle and hauled up the inclined trestle by means of the derrick engine and heavy four-sheave blocks and tackle. After the gun had been mounted it was thrown in battery, a machinist's level was placed on the muzzle, and the gun traversed through the whole field of fire. No variation whatever was shown by the level. The cost of the labor of moving the gun and carriage from the wharf and mounting them was $913.55. The breech block was put in the gun on March 8 by a machinist from the Watertown Arsenal.

The third 12-inch gun was received on March 22, 1898, and moved to the rear of emplacement No. 3. The remaining parts of 12-inch dis-

appearing carriage No. 1 arrived on April 25, 1898. They were taken to emplacement No. 1 and assembled, the mounting of the carriage being completed on May 12, 1898. Notice was that day received from the Chief of Ordnance that the distance rings furnished with the carriage were to be replaced by new ones with separators. This required the partial dismounting of the carriage. The new rings arrived on May 25, 1898, and were at once put in place; the carriage was then reassembled, and on June 3 the gun was mounted ready for service. The new rings greatly increased the ease with which the carriage can be traversed.

The third 12-inch disappearing carriage for emplacement No. 3 was received and unloaded on May 12, 13, and 16. On this carriage the four stiffening flanges at the joints in the bedplate had to be cut back 4 inches to make room for the leveling wedges. Eight of the radial ribs on the under side of the racer had to be chipped to clear the flanges of the rollers. The work of mounting this carriage was suspended from May 24 to June 4 while the force was engaged on changing the distance rings on carriage No. 1. The gun and carriage were finally mounted and ready for service on June 16, 1898. The first troops to garrison the battery arrived December 14, 1897.

None of the 10-inch or 12-inch guns in this battery had been fired up to the close of the fiscal year.

The cost of the battery proper up to June 30, 1898, including the electric plant, hoists, telephone booths, etc., was $241,692.38. The cost of the parados during the same period was $9,862.28. In addition, $3,702.53 were spent in making the road to the wharf, $1,209.42 in building latrines in the parados, and $6,665.84 in transporting and mounting the six guns and carriages.

Battery for two 5 inch rapid-fire guns.—The two emplacements for 5-inch rapid fire guns on balanced-pillar mountings are situated about 100 feet beyond the western end of the main battery. Excavation for the foundations began on June 8, 1897, and the rapid-fire battery was completed in August, 1897, ready for the guns and carriages. None have yet been received.

This battery does not follow the typical design of The Board of Engineers, but is planned to be protected from fire from its rear, to which it is exposed, and to bring the fire of its two guns to bear in the same direction. Its crest is kept at the same reference as that of the main battery, the two magazines being placed below the gun platforms. These are connected by a passageway, into which opens a chain ammunition hoist for the service of each gun. The hoists can be worked either by hand or by electric motors. The current to operate the motors and to light the battery can be obtained either from the power plant of the main battery or from an independent plant in the rapid-fire battery. The motors and lights are connected permanently with both sources of power, so that either source can be switched on at pleasure. A 3 kilowatt dynamo operated by an oil engine was first installed in the rapid-fire battery and left there several months. It was finally rejected, the contractors after repeated tests having failed to make it comply with the requirements of the specifications. Its place has been taken by the 10-kilowatt dynamo, direct connected to a steam engine, furnished with the search light sent to the fort.

The two emplacements contain 2,266 cubic yards of masonry and the embankment 6,944 cubic yards of earth. The total cost of the battery up to June 30, 1898, was $19,529.54.

The following table gives the cost of this battery in detail:

6,943.6 cubic yards of excavation, at $0.169008 per cubic yard	$1,173.53
2,266 cubic yards of concrete masonry in place, at $4.98632 per cubic yard	11,298.99
6,943.6 cubic yards of earth filling in embankments, at $0.30275 per cubic yard	2,102.17
Tearing out two old platforms on site of battery	126.57
Waterproofing exterior walls with tar	96.40
I-beams and channels for ceilings of rooms and passages (in place)	274.44
Two iron stairways (in place)	376.80
Two ammunition hoists (in place)	966.76
Cost of doors (in place)	574.16
Drainage system	228.84
Electric light and power system	583.84
Remodeling two old magazines for machine guns	287.92
Amount expended on installation of search light and boiler, which takes the place of oil-engine plant (not yet completed)	162.17
Superintendence and office expenses	1,006.95
Total	19,259.54

EXPENDITURES DURING THE FISCAL YEAR FROM ALLOTMENT FOR BATTERY.

Amount expended on rapid-fire battery	$14,817.45
Moving from the wharf and mounting three 12-inch guns and carriages	4,187.74
Cleaning, oiling, and painting guns and carriages	171.44
Amount expended on parados	9,862.28
Cost of two latrines in parados	1,209.42
Completing concrete work	188.10
Completing earth embankment in front of battery	1,241.54
Completing roadway in rear of battery	1,798.46
Completing drainage system	114.10
Completing speaking-tube system	7.00
Completing plant for permanent water supply	138.09
Amount expended on stairways	1,285.37
Amount expended on interior ammunition service	557.78
Amount expended on guard rails in rear of loading platforms	729.50
Ammunition cranes in rear of loading platforms	128.80
Ammunition hoists	5,020.15
Completing installation of electric plant, including its cost	7,587.26
Completing laying of conduits for electric wires, including cost	557.75
Painting and waterproofing interior walls	441.46
Lamps for lighting passages	78.53
Clearing and grading adjacent grounds	377.41
Planting trees along roadway and boundary of reservation	37.50
Iron ladders on loading platforms	182.70
Repairing, moving, and tearing down old buildings	465.88
Storm doors for battery (in place)	626.51
Painting pavements on superior slopes	284.87
Repairs and maintenance of plant	474 82
Telephone system (not completed)	183.24
Taking down concrete plant	862.23
Time allowed employees for legal holidays	576.00
Maintenance of launch for mail service	901.08
Services of watchmen	201.33
Superintendence and office expenses	643.16
Total expenditure	55,938.95

Money statement for the entire battery.

July 1, 1897, balance unexpended	$106,747.53
February 28, 1898, amount transferred from appropriation for "Torpedoes for Harbor Defense," originally charged to allotments for this battery	286.18
	107,033.71
June 30, 1898, amount expended during fiscal year	67,048.03
July 1, 1898, balance unexpended	39,985.68
July 1, 1898, outstanding liabilities	2,697.67
July 1, 1898, balance available	37,288.01

Battery of three 12-inch disappearing guns.—The preliminary work on the foundations of this battery began on December 11, 1894. Accounts of the progress of the work are contained in the Annual Reports of the Chief of Engineers for 1896 and 1897. At the close of the latter fiscal year the driving of piles for the foundations was practically completed; the construction plant was reported to be in good condition, and everything in readiness to carry forward the work rapidly whenever funds were allotted.

On August 5, 1897, an allotment of $58,000 was made from the appropriation for "Gun and Mortar Batteries," act of March 3, 1897, to complete the concrete foundations up to the level of the parade. Work began on August 11, 1897, when a centrifugal pump was set up to pump out the water with which the foundation pit had been flooded in order to preserve the heads of the piles. As soon as the pit was clear of water, the remaining piles necessary to complete the foundations, 45 in number, were driven under the casemate arches. Track was laid from the concrete plant to the pit, and engines, cars, derricks, mixers, and other parts of the plant which had been temporarily transferred to another work were brought back and set up. Good water for the boilers was obtained by connecting the work by a 3-inch pipe with an artesian well 1,000 feet distant. Four thousand eight hundred and five cubic yards of mud were dredged from between and around the piers of the wharf, a depth of 10 feet at mean low water being thus secured. Nine hundred and eighty-five cubic yards of earth were removed from around the heads of the piles to reference —0.5 of the old fort, i. e., 2.3 feet below the level of mean low water. At this point the first layer of concrete was placed; it was carried up over the pile foundations in a solid mass to reference 10.5, 6 inches below the level of the magazine floors of the projected battery. All pile heads that were in the least battered, and all standing above reference 2.25 were cut off. No large stones were placed in the concrete below reference 4.25—that is, 2 feet above the heads of the piles. The placing of concrete under the project was completed on December 15, 1897, 10,388 cubic yards of masonry, including concrete and large stones, being in place on that date. The foundations had everywhere been carried to reference 10.5, and under some parts of the wall slightly higher. A 24 inch sewer was built through the concrete leading to the moat and along the rear of the battery for the drainage of the fort and of the new battery. It was connected to the old sewerage system. The spaces between the battery proper and the outer parapet wall were filled with sand, the excavation around the foundations was filled in, and the exposed top of the concrete was covered with sand to a depth of 6 inches to protect it. This brought the whole of the foundations up to the level of the parade, and completed the project. The work of filling was completed on January 25, 1898, 3,970 cubic yards of sand having been purchased and used for the purpose. Beyond cleaning up around the work and overhauling and repairing the plant, no work has since been done. A large part of the plant has been transferred to the Delaware shore and used on fortification work there. It can be returned and used in continuing the work on the battery as soon as additional funds are allotted. The cost of this battery to June 30, 1898, was $181,043.44.

Net cost of concrete, 10,388 cubic yards.

MATERIAL.

8,686.62 cubic yards of small stone, at $1.09 per cubic yard	$9,468.42	
Labor, unloading, hauling, and storing	1,978.75	
		$11,447.17
1,548.65 tons large stone, at $0.751693 per ton	1,164.11	
Labor, unloading, hauling, and placing	610.85	
		1,774.96
2,739.49 cubic yards of sand for concrete, at 28 cents per cubic yard	767.04	
Labor, unloading, hauling, and storing	505.42	
		1,272.46
13,673 barrels Rosendale cement, at 70 cents per barrel	9,571.10	
Labor, unloading, hauling, and storing	650.68	
		10,221.78
		24,716.37

MANUFACTURE AND DEPOSIT.

Labor, mixing concrete	$1,765.92	
Labor, placing and tamping concrete	3,692.86	
Labor, building and setting forms and centers	484.05	
Coal, and cost of labor hauling same	269.09	
		$6,211.92
Total		30,928.29

Net cost of 1 cubic yard in place, $2.9773.

Gross cost of concrete, 10,388 cubic yards.

Net cost of 10,388 cubic yards of concrete in place, at $2.9773 per cubic yard		$30,928.29
Transferring plant	$127.83	
Purchase, construction, and installation of plant	1,895.96	
Cost of flat and mixer cars	74.56	
Cost of new derricks	237.76	
Moving and setting up derricks	1,147.89	
Construction tracks	594.72	
Water supply	303.95	
Drainage system	602.20	
Repairs and maintenance of plant	2,157.88	
Repairs to electric plant	470.46	
Time allowed employees for legal holidays	457.79	
Maintenance of launch	642.03	
Testing cement	100.00	
Superintendence and office expenses	1,895.05	
		10,708.08
Total		41,636.37

Gross cost of 1 cubic yard in place, $4.008122.

Cost of sand filling in core of foundations.

3,970.17 cubic yards of sand, at 25 cents per cubic yard	$992.54
Labor, unloading	631.03
Labor, hauling	119.40
Labor, placing	480.31
Cost of storage bins on wharf	41.36
Repairs to plant	148.16
Superintendence and office expenses	300.68
Total	2,713.48

Cost of 1 cubic yard in place $0.683467.

Expenditures for fiscal year ending June 30, 1898.

10,388 cubic yards of concrete, at $4.008122 per cubic yard		$41,636.37
3,970.17 cubic yards of sand filling, at $0.683467 per cubic yard		2,713.48
Excavation around pile heads		818.18
Driving piles	$267.85	
Cutting off pile heads	510.47	
Removing ends of piles from pit	281.36	
		1,059.68
Draining the moat		192.32
Repairs to landing piers		576.60
Clearing and grading grounds outside and inside of fort		957.39
Moving and shipping torpedoes		82.20
Value of construction materials on hand		418.57
Total expenditure		48,454.79

A special allotment of $6,000 was made on April 21, 1898, from the appropriation for "National Defense," act of March 9, 1898, for cleaning out the moat around the fort and the ditches on the island. Authority was obtained, however, to defer the work until cold weather on account of the extra expense and the danger to the health of the garrison involved in stirring up the mud to be removed in warm weather.

Money statement.

July 1, 1897, balance unexpended		$7,506.56
August 5, 1897, additional allotment		58,000.00
April 21, 1898, amount allotted from appropriation for "National Defense," act of March 9, 1898, for cleaning out moat and ditches		6,000.00
		71,506.56
December 20, 1897, amount withdrawn from allotment		10,000.00
		61,506.56
July 1, 1898, amount expended during fiscal year		48,550.00
July 1, 1898, balance unexpended		12,956.56
July 1, 1898, balance available as follows:		
For work on battery	$6,956.56	
For cleaning out moat and ditches	6,000.00	
		12,956.56

Battery of sixteen 12-inch mortars.—The allotment for the construction of this battery was made on June 4, 1897. Specifications were at once issued for the principal construction materials needed; the greater part of the plant required was transferred from other works.

The preliminary work of construction began on June 24, 1897. The old wharf leading to the reservation was repaired and extended 336 feet into the river, at a cost of $3,965.57. In addition, a movable bridgeway for transferring railroad cars from floats was erected on one side of the wharf by the contractors for delivering stone; this work was done without expense to the United States. A boring 35 feet deep was made to determine the nature of the soil for the foundations; it was found to resemble that on the New Jersey side of the river, where the settlement had been uniform and not very great. Old wooden buildings on the reservation were repaired and fitted up for offices, carpenter and blacksmith shops, and storehouses. The site of the battery was cleared, and on July 30, 1897, excavation for the foundations was begun; the total amount thus excavated was 5,100 cubic yards. Concrete was supplied by 2 cubical mixers, from which it was carried on cars to derricks and by them swung to the part of the work under construction. Stone for concrete was delivered on cars on floats at the movable bridgeway, and hauled by a locomotive up an inclined trestle

leading directly over the sand and stone bins. Washed sand was received on open-deck barges, from which it was transferred by buckets operated by derricks into cars and hauled to the storage bins. Mixer cars running under the bins received their charges of stone and sand through slides and were then hauled by cables to the mixers. Concrete work was suspended for the winter on December 18, 1897, and resumed on March 26, 1898. During this interval the placing of sand in the embankment around the battery was begun. The sand was dredged from the Delaware River near the work, and was delivered by the contractor on open-deck barges alongside the Government wharf, at 23¼ cents per cubic yard; the handling and placing of the sand was done by the Engineer Department. For this purpose a locomotive and 24 side-dumping cars were purchased, and a small bin raised above the car tracks was built across the wharf; into it the sand was dropped by buckets operated by four derricks. The cars were run under the bin and filled by opening slides in its bottom. Clam-shell buckets were at first used to transfer the sand from the barges to the bin, but they were afterwards replaced by ordinary steel coal buckets, each filled on the barge by two men; it was found possible to operate more rapidly with them than with the clam-shell buckets. The placing of sand was suspended when concrete work was resumed in the spring, but it was begun again on June 21. The total amount placed during the fiscal year was 19,927 cubic yards, but of this amount 2,945 cubic yards were taken away and used in the construction of the emplacements for 8-inch and 12-inch guns. Adding to the sand the 5,100 cubic yards excavated for the foundations, the total amount of material placed in the embankment around the battery was 22,082 cubic yards.

At the close of the fiscal year the masonry of the battery was practically completed, the only concrete work remaining to be done being the blast-slopes around each mortar pit. They can not be built until the sand filling against which they are to rest has reached a sufficient height. The total amount of concrete, including large stones, placed in the battery, is 15,511 cubic yards, of which 1,053 cubic yards are in the mortar platforms. Eight of the latter are built entirely of Portland concrete; the other 8 have foundations of Portland concrete topped by two layers of cut granite.

The battery itself follows generally the typical design of The Board of Engineers. It is subject to hostile fire through an arc of 200°; the amount of cover on the side not exposed to fire is reduced; the entrances to the pits are placed on this side, as well as rooms for the electric-lighting plant and for directing the firing. The height of the embankments around the battery is to be 5 feet less than that called for by the typical design. A storage capacity of 200 rounds of ammunition per gun is provided; this was accomplished by slightly increasing the width of the powder magazines and by enlarging the two magazine recesses connected with the longitudinal gallery. In each recess are to be placed two overhead traveling cranes, supporting sections of trolley rail, which can be brought into prolongation of the line of rails running along the side of the gallery. The electric lights of the battery are placed in lamps of the marine standard type. All wires are carried in overhead iron-armored conduits. Current is supplied by a storage battery having a capacity of 50 amperes for eight hours. The battery is charged from a booster and motor, direct connected, which receive their current from the main power plant in the 8-inch battery, a third of a mile distant. The location of the firing room places it beyond the influence of

the concussion produced by firing the mortars. It is connected by telephone with a booth in each pit, the wires being run in overhead conduits through the battery. Wires run from the firing room to each mortar in underground conduits through the entrances to the pits.

The top slopes of the concrete over the magazines and passages are covered with a layer of asphalt three-fourths of an inch thick. The asphalt is composed of Seyssel mastic, sand, and bitumen; it was put on by contract at $1.26 per square yard, the contractor guaranteeing under bond to repair at his own expense any leaks developing in it within fifteen years of completion. The vertical sides of the concrete are coated with two layers of coal tar, and are drained by a 3-inch tile drain, which runs around the entire battery and is connected at intervals with the main drainage system.

A pump room is built in the concrete wall, forming the side of the entrance to the northern pits. The pump has a capacity of 1,800 gallons an hour, and is operated by an electric motor. The water is to be pumped from driven well points into a tank built into the rear slope of the battery, and connected by pipes with each of the pits and with the intersections of the galleries.

At the close of the fiscal year the masonry of the battery was completed, with the exception of 1,300 cubic yards still to be placed in the blast-slope around the pits. All 16 mortar carriages and 8 mortars were mounted; the remaining 8 mortars had not been received. The cost of the battery up to June 30, 1898, was $130,461.30. In addition, the repairs and extension to the wharf leading to the reservation had cost $3,965.57, and mounting the guns and carriages had cost $4,619.05.

The methods of construction, the distribution of the gangs, etc., on this work were exactly similar to those at the battery for 10-inch and 12-inch disappearing guns and 5-inch rapid-fire guns, a detailed report of which is contained in the Annual Report of the Chief of Engineers for the fiscal year ending June 30, 1897.

The following contracts were in force during the year:

With the Lawrenceville Cement Company, New York, N. Y., dated July 30, 1897, approved August 13, 1897, for furnishing and delivering 25,000 barrels of Beach's brand of American Rosendale cement, at 71 cents per barrel, first delivery to be made between July 25 and August 15, 1897, final delivery not specified. This contract was satisfactorily completed on May 3, 1898, a total of 26,053 barrels having been delivered under it.

With the Delaware Construction Company, Wilmington, Del., dated July 29, and approved August 16, 1897, for furnishing and delivering 15,000 cubic yards of small broken stone, at $1.23 per cubic yard, first delivery to be made between July 25 and August 15, 1897, final delivery not specified.

With the Charles Warner Company, of Wilmington, Del., dated July 29, and approved September 17, 1897, for furnishing and delivering 7,500 cubic yards of building sand, at 28 cents per cubic yard, first delivery to be made between July 25 and August 15, 1897, final delivery not specified.

With the Delaware Construction Company, of Wilmington, Del., dated December 31, 1897, approved January 24, 1898, for furnishing and delivering about 150,000 cubic yards of unwashed sand for embankments, at 23¼ cents per cubic yard, first delivery to be made on or about January 3, 1898, final delivery at such time after June 1, 1898, as will complete the contract.

The following tables show the quantity and cost of each kind of material used, and the expenditure during the fiscal year:

Quantity of each kind of material used, and average cost delivered on or alongside the wharf.

26,053 barrels Rosendale cement, per barrel	$0.71
2,200 barrels Portland cement, per barrel	1.8445
13,429.63 cubic yards small broken stone, per cubic yard	1.23
5,056.06 cubic yards sand for concrete, per cubic yard	.28
1,853.24 tons large broken stone, per ton	.85
19,927 cubic yards sand for embankments, per cubic yard	.2325
207,221 pounds steel I-beams, channels, columns, and girders, per pound	.013
384 anchor bolts, each	1.65
8 sets granite stones for platforms, per set	532.00
3,000 feet unglazed tile drain	72.00
428 feet cast-iron pipe, 4-inch, 6-inch, and 12-inch	106.97
1,303 feet extra heavy wrought-iron pipe, 2½-inch, 1½-inch, and 1-inch	137.67
2,440 feet sewer pipe, 6-inch, 8-inch, 10-inch, and 12-inch	295.92
19 manholes, each	7.19
8 hand-holes, each	2.00
148,492 feet yellow pine lumber, per 1,000 feet	18.87
320 feet white pine lumber, per 1,000 feet	20.00
2,000 feet hemlock, per 1,000 feet	16.50
720 feet oak lumber, per 1,000 feet	45.00
38,850 shingles, per 1,000	4.72
1,500 railroad ties, each	.382
55 tons steel rails, per ton	21.96
6,200 pounds railroad spikes, per 100 pounds	1.78
300 pairs fish plates for track, per pair	.23
290 fish plates for wharf, each	.10
222 tons anthracite coal, per ton	4.448
142 tons bituminous coal, per ton	2.243
10,824 pounds iron, per pound	.0186
533 pounds round machinery steel, per pound	.0229
75 barrels coal tar, per barrel	3.69
11,605 pounds cut nails, per pound	.0134
6,861 feet iron-armored conduit, $1\frac{8}{10}$-inches, $1\frac{4}{10}$-inches, $\frac{9}{10}$-inch, and $\frac{7}{10}$-inch, including connections	516.41
2,160 feet pump log conduit, per foot	.045
10,175 feet electric wire, No. 14, No. 10, No. 8, No. 4, and No. 1	229.28
2,154.16 square yards mastic, per square yard in place	1.26
11 cars cinders, per car	5.00

AVERAGE COST OF HANDLING MATERIALS.

Cement, per barrel:	
Unloading	$0.0235
Hauling	.0049
Storing	.0197
Small broken stone, per cubic yard:	
Unloading and storing	.0784
Hauling	.0260
Sand for concrete, per cubic yard:	
Unloading	.1258
Hauling	.0322
Storing	.0227
Large broken stone, per ton:	
Unloading	.0604
Hauling	.0331
Storing	.0071
Placing in walls	.2523
Sand for embankments, per cubic yard:	
Unloading	.11455
Hauling	.01555
Placing	.06813
Excavation, per cubic yard	.418723
Setting anchor bolts, each	.448

AVERAGE COST OF MATERIALS IN PLACE.

Concrete masonry in walls of magazines and galleries, 14,457.7 cubic yards:	
Framing (labor, lumber, nails, etc.)	$4,875.13
Materials (cement, sand, small and large stone, and coal)	41,835.42
Mixing	3,253.46
Placing and ramming	6,394.89
Preparing floors and laying pavements in magazines and galleries	545.62
Finishing face walls and pavements	755.83
Cutting and setting corner stones at intersection of galleries	362.06
Testing cement	249.07
Total	58,271.48

Cost in place, per cubic yard, $4.03048.

Masonry in platforms in two northern mortar pits, composed of 435.2 cubic yards concrete and 100 cubic yards cut stones, total of 535.2 cubic yards:	
Framing (labor, etc.)	431.90
Materials (cement, sand, and small stone)	1,877.78
Mixing	194.33
Placing and ramming	600.36
Cost of 8 sets of cut stones	4,256.00
Labor (unloading, hauling, and setting stones)	631.45
Cost of anchor bolts (192)	253.44
Labor (setting bolts)	43.26
Total	8,288.52

Cost in place, per cubic yard, $15.486.

Masonry in platforms in two southern mortar pits, 518 cubic yards (all concrete):	
Framing (labor, etc.)	506.68
Materials (cement, sand, and small stone)	2,235.20
Mixing	298.96
Placing and ramming	732.29
Cost of anchor bolts (192)	253.44
Labor (setting bolts)	128.72
Deepening holes for bolts	228.81
Total	4,384.10

Cost in place, per cubic yard, $8.463.

The additional cost of setting the anchor bolts in these platforms was caused by constructing the platforms before the bolts were received. Empty cement barrels were placed in the positions for the bolts, and the bolts set in these holes after the platforms were nearly completed. These holes had to be deepened afterwards, because the overseer had not set the barrels at the right elevation.

Sand filling:	
19,927 cubic yards sand, at 23¼ cents per cubic yard	$4,633.02
Unloading	2,282.59
Hauling	309.81
Placing	1,357.59
Shifting tracks and maintenance of plant	2,507.27
Storage bins on wharf	247.80
Total	11,338.08

Cost in place per cubic yard, $0.56898.

Cost of unloading and mounting sixteen mortar carriages and eight mortars.

Unloading mortar carriages	$754.49	
Setting bedplates and racers	1,572.74	
Assembling top carriages	1,653.32	
		$3,980.55
Unloading mortars	89.51	
Mounting mortars	548.99	
		638.50
Total		4,619.05

Total cost of work to June 30, 1898.

14,457.7 cubic yards of masonry in walls of magazines and galleries, at $4.03048 per cubic yard	$58,271.48
518 cubic yards of masonry in platforms of two southern mortar pits (all concrete), at $8.4635 per cubic yard	4,384.10
535.2 cubic yards of masonry in platforms of two northern mortar pits (including 100 cubic yards of cut stones), at $15.486 per cubic yard	8,288.52
5,100 cubic yards of excavation for foundations, at $0.418723 per cubic yard	2,135.49
19,927 cubic yards of sand for embankment in front of battery, at $0.56898 per cubic yard	11,338.08
Cost of I-beams, channels, girders, etc., 207,221 pounds	2,695.41
Cost of connecting and setting I-beams, channels, and girders, etc	390.29
Unloading and mounting mortars and carriages	4,619.05
Cleaning, oiling, and painting guns and carriages	153.56
Clearing site for battery	177.95
Repairs and extension to wharf	3,965.57
Purchase, construction, and installation of plant	13,008.62
Plant for water supply	990.18
Electric-light plant (not complete)	2,763.42
Drainage system	2,312.00
Repairs and maintenance of plant	3,668.66
Moving and repairing buildings	945 49
Waterproofing exterior walls with tar	469.61
Waterproofing with asphalt mastic	3,473.39
Electric conduits (not complete)	617.64
Storing ammunition	52.74
Telephone system (not completed)	286.05
Building dynamo room in mining casemate	258.13
Maintenance of launch for mail service	1,630.74
Time allowed employees for legal holidays	997.37
Superintendence and office expenses	6,389.52
	134,283.06
Outstanding liabilities, and value of construction materials on hand	1,734.00
Total	136,017.06

Money statement.

July 1, 1897, balance unexpended		$175,000.00
June 30, 1898, amount expended during fiscal year		130,461.30
July 1, 1898, balance unexpended		44,538.70
July 1, 1898, outstanding liabilities	$5,542.76	
July 1, 1898, amount covered by uncompleted contracts	36,438.42	
		41,981.18
July 1, 1898, balance available		2,557.52

Abstract of proposals for furnishing and delivering broken stone and sand at the Government wharf, opened July 12, 1897, by Maj. C. W. Raymond, Corps of Engineers.

No.	Name and address of bidder.	Small broken stone, 15,000 cubic yards.		Sand, 7,500 cubic yards.	
		Per cubic yard.	Total.	Per cubic yard.	Total.
1	Delaware Construction Co., Wilmington, Del	$1.23	$18,450.00	$0.32	$2,400.00
2	Michael Herron, Bordentown, N. J			.33	2,475.00
3	Brandywine Granite Co., Wilmington, Del	1.24½	18,675.00		
4	Robert Patterson, trading as Robert Patterson & Son, Philadelphia, Pa	1.33	19,950.00	.39¾	2,981.25
5	Irvine & Carty, New York, N. Y	1.65	24,750.00		
6	Perryville Granite Co., Philadelphia, Pa	1.44	21,600.00		
7	Charles Warner Co., Wilmington, Del			.28	2,100.00
8	Standard Lime and Stone Co., Baltimore, Md	1.25	18,750.00		

Contracts entered into as follows:
With Delaware Construction Company, dated July 29, 1897, for the broken stone.
With Charles Warner Company, dated July 29, 1897, for the sand.
Both contracts in progress.

Abstract of proposals for furnishing and delivering about 150,000 cubic yards of sand alongside the Government wharf at the United States reservation, opened December 20, 1897, by Maj. C. W. Raymond, Corps of Engineers.

No.	Name and address of bidder.	Unwashed sand, 150,000 cubic yards.	
		Per cubic yard.	Total.
1	Patrick Neary and D. Connell, Wilmington, Del	$0.35	$52,500
2	Robert Patterson, trading as Robert Patterson & Son, Philadelphia, Pa	.40	60,000
3	Delaware Construction Co., Wilmington, Del	.23¼	34,875
4	Frank H. Caven, Philadelphia, Pa	.32	48,000
5	George W. Ruch, Philadelphia, Pa	.42½	63,750
6	Morris & Cumings Dredging Co., New York, N. Y	.23 4/10	35,100
7	Charles Warner Co., Wilmington, Del	.30	45,000

Contract (dated December 31, 1897) entered into with the Delaware Construction Company. In progress.

List of all contracts in force, with names of contractors, date of approval, of beginning work, and expiration.

With the Charles Warner Company, Wilmington, Del., dated July 29, 1897, and approved September 17, 1897, for furnishing and delivering about 7,500 cubic yards of building sand, at 28 cents per cubic yard, first delivery to be made between July 25 and August 15, 1897; no date fixed for final delivery.

With the Delaware Construction Company, Wilmington, Del., dated July 29, and approved August 16, 1897, for furnishing and delivering about 15,000 cubic yards of small broken stone, at $1.23 per cubic yard; first delivery to be made between July 25 and August 15, 1897; no date fixed for final delivery.

With the Delaware Construction Company, Wilmington, Del., dated December 31, 1897, and approved January 24, 1898, for furnishing and delivering about 150,000 cubic yards of unwashed sand, at 23¼ cents per cubic yard; first delivery to be made on or about January 3, 1898, final delivery at such time after June 1, 1898, as will complete the contract.

Torpedo storage shed.—On March 30, 1897, the sum of $7,200 was allotted from the appropriation for "Torpedoes for Harbor Defense," act June 6, 1896, for the construction of a fireproof shed for the storage of torpedo material. The shed was completed on November 29, 1897, at a total cost of $5,588.50. The building is of brick, on a grillage foundation. The roof is of corrugated iron, laid on steel purlins supported by steel trusses. A single track, 36-inch gauge, runs through the center of the building and out by a door at each end; it connects with the trolly line leading to the wharf. For handling material and loading and unloading it, an overhead traveling crane runs from one end of the building to the other. Room is provided for storing 236 mines, with necessary buoys, junction boxes, coils of rope, and other materials. For the storage of the smaller and more delicate parts of the submarine-mining apparatus a room 11 by 11 feet is partitioned off from one corner of the building. Mine anchors are piled on a platform placed on the ground just beyond one end of the shed. It is lighted by five windows in each side, protected by iron shutters.

Money statement.

July 1, 1897, balance unexpended		$6,333.47
June 30, 1898, amount expended during fiscal year	$5,008.15	
February 28, 1898, amount deposited to credit of the appropriation	1,325.32	
		6,333.47

Preservation and repair of fortifications.—On June 14, 1897, the Chief of Engineers allotted the sum of $325 from the appropriation for "Preservation and Repair of Fortifications," act of March 3, 1897, to be applied to the works in the vicinity of Fort Delaware, Del. Under this allotment the fences on one reservation were repaired, and two new gates built at the entrance, and two sluice gates with winches were purchased, under circular and specifications dated April 10, 1898, for another work, to be delivered within three weeks of May 16, 1898. At the end of the fiscal year the gates had not yet been delivered.

Money statement.

July 1, 1897, balance unexpended	$325.00
June 30, 1898, amount expended during fiscal year	75.00
July 1, 1898, balance unexpended	250.00
July 1, 1898, amount covered by uncompleted contracts	250.00

Emplacement for 8-inch rifles.—The approved project under which work is being carried on provides for the construction of two emplacements for 8-inch disappearing guns at an estimated cost of $74,000. On March 18, 1898, the sum of $50,000 was allotted by the Chief of Engineers for the construction of these emplacements from the appropriation for "National Defense," act of March 9, 1898, with authority to purchase all materials in open market, and on April 1, 1898, the remaining $24,000 were allotted from the same appropriation to complete the emplacements.

Preliminary work for the construction of the battery began on March 21, 1898. As soon as the allotment was received steps were taken to purchase in open market, as authorized, the principal construction materials needed, and arrangements were made and agreements entered into with the contractors who are furnishing construction materials for the mortar battery, to furnish and deliver materials as follows:

With the Lawrenceville Cement Company, New York, N. Y., to furnish and deliver 6,000 barrels of "Beach's" brand of American Rosendale cement, at 71 cents per barrel, first delivery to be made about May 5, 1898, the terms of delivery and requirements to be the same as in their contract dated July 30, 1897, for furnishing and delivering cement for the mortar battery.

With the Delaware Construction Company, of Wilmington, Del., to furnish and deliver about 8,000 cubic yards of small broken stone, at $1.23 per cubic yard, first delivery to be made April 1, 1898, the terms of delivery and requirements to be the same as in their contract dated July 29, 1897, for furnishing and delivering small broken stone for the mortar battery.

With the Delaware Construction Company, of Wilmington, Del., to furnish and deliver about 2,000 tons of large broken stone, at 85 cents per ton, first delivery to be made April 1, 1898, the terms of delivery and requirements to be the same as in their informal contract dated September 17, 1897, for furnishing and delivering large broken stone for the mortar battery.

With the Charles Warner Company, of Wilmington, Del., to furnish and deliver about 1,500 cubic yards of building sand for concrete, at 28 cents per cubic yard, first delivery to be made April 7, 1898, the terms of delivery and requirements to be the same as in their contract for furnishing and delivering sand for the mortar battery.

An agreement was also entered into with the Atlas Portland Cement Company, No. 143 Liberty street, New York, N. Y., to furnish and

deliver 1,300 barrels of "Atlas" brand of American Portland cement, at $2.15 per barrel, delivery to be made on or before April 15, 1898.

An agreement was also entered into with the Lawrence Cement Company, of Philadelphia, Pa., to furnish and deliver 6,000 barrels of "Hoffman's" Rosendale cement, at 80 cents per barrel, 3,000 barrels to be delivered April 20, and 3,000 on April 27, 1898.

Before the end of the month of March, 1898, lumber for the concrete plant and ties and steel rails for the construction track had been delivered and the necessary excavation for the sand and stone bins had been made; railroad track had been laid from the wharf to the site of the proposed emplacements, a distance of 1,800 feet, and the construction and erection of the plant begun. The general arrangement of the plant and the methods of construction used are exactly similar to those employed in the construction of the battery for 10-inch and 12-inch disappearing guns and 5-inch rapid-fire guns, a detailed report of which will be found in the Annual Report of the Chief of Engineers for the fiscal year ending June 30, 1897. Engines, derricks, cars, concrete mixers and mixer frames, and trestles were transferred from another work and their installation commenced. Proposals for I-beams, channels, anchor boats, etc., had been sent out with quick delivery required under penalty.

The excavation for the foundations was commenced on April 1, 1898, and completed on April 27, 1898, a total of 944 cubic yards being removed and deposited in front and rear of the battery for embankments.

The concrete plant was ready for operation on April 8, 1898, on which date mixing and placing of concrete was commenced. It was carried on from ten to fourteen hours a day until June 8, 1898, on which date the masonry of the battery was practically completed, including pavements of magazines and passages and superior slopes. During this time 6,940 cubic yards of Rosendale concrete and 50 cubic yards of Portland concrete were placed in the parapet and magazine walls, and 1,000 cubic yards of Rosendale concrete and 350 cubic yards of Portland concrete in the two platforms.

The platforms, as far as possible, were constructed first. The foundation bolts were set and the platforms were ready for the carriages on April 24, 1898, for the south platform, and on May 1, 1898, for the north platform, respectively.

The platforms having been practically completed, the carriages and guns were mounted as follows:

South emplacement.—Carriage No. 13, received April 21, mounted May 7, 1898, and gun No. 19, received April 18, mounted May 11, 1898.

North emplacement.—Carriage No. 8, received April 21, mounted May 16, 1898, and gun No. 20, received April 18, mounted May 18, 1898.

The breech mechanisms were put in, the recoil cylinders filled with oil, the stuffing boxes packed, and the guns made ready for service.

During April 1,197 cubic yards of sand, taken from the embankment at the mortar battery, were placed in the sand cores of the foundations and platforms.

The two completed emplacements contain 7,940 cubic yards of Rosendale concrete and 400 cubic yards of Portland concrete. The exterior walls are faced with Portland mortar 2 inches thick, mixed in the proportion of 1 cement and 3 sand. The interior face walls and the pavements of the magazines and passages are of Portland mortar 2 inches thick, mixed in the proportion of 1 to 4. The rear walls of the shot chambers of the platforms are built of Portland concrete. The pavement on the superior slope not exposed to the blast of the guns is

composed of 2½ inches to 3 inches of Portland mortar, 1 to 2. Where exposed to the blast of the guns it has 6 inches of Portland mortar, 1 to 2, for the south emplacement, and 12 inches of Portland concrete, 1 to 3 to 7½, and 2 inches of Portland mortar, 1 to 2, for the north emplacement. The ceilings of all the magazines and passages are built in between the I-beams with flat arches of hollow tile.

The magazines and passages are completely waterproofed by a layer of asphalt concrete 2 inches thick, beginning at reference 14 and extending up the sides and over the tops at an average distance of 3 feet from the face walls and ceilings; 783.23 square yards of this asphalt concrete were laid under contract with W. S. P. Shields, Philadelphia, Pa. Pavements of the loading platforms over the shot chambers are made of asphalt mastic 1 inch thick.

The installation of the engines, dynamos, and boiler for the electric light and power plant was nearly completed at the close of the fiscal year. This plant is designed to furnish the necessary power for operating the ammunition hoists and for furnishing light for both the 8-inch and 12-inch emplacements, as well as for charging the storage battery at the mortar battery.

The work remaining to be done consists in completing the embankment in front of the battery; in installing the electric light and power plant; in placing the ammunition hoists and the system for the service of ammunition; in erecting stairways and ammunition cranes in rear of the loading platforms, and balconies in rear of the traverses to connect the platforms, and in hanging the doors. A small amount of concrete also remains to be placed in the parapet to connect it with the adjacent 12-inch emplacements.

The following tables show the cost of each kind of work as far as completed at the end of the fiscal year:

Masonry in parapet and traverses, composed of 6,940 cubic yards of Rosendale concrete and 50 cubic yards of Portland concrete, a total of 6,990 cubic yards:

Framing (labor, lumber, nails, etc.)	$2,549.90
Materials (cement, sand, small and large stone, and coal)	18,233.31
Mixing	1,569.05
Placing and ramming	3,398.29
Preparing floors and laying pavements in magazines and on superior slope	275.69
Total	26,026.24

Per cubic yard in place, $3.72335.

Masonry in gun platforms, composed of 1,000 cubic yards of Rosendale concrete and 350 cubic yards of Portland concrete, a total of 1,350 cubic yards:

Framing (labor, lumber, nails, etc.)	$564.72
Materials (cement, sand, and small stone)	4,397.07
Mixing	266.99
Placing and ramming	557.59
Total	5,786.37

Per cubic yard in place, $4.2862.

Expenditures to June 30, 1898.

6,990 cubic yards of concrete masonry in parapet and traverses, at $3.72335 per cubic yard	$26,026.24
1,350 cubic yards of concrete masonry in gun platforms, at $4.2862 per cubic yard	5,786.37
944 cubic yards of excavation for foundations, at $0.27378 per cubic yard	258.46
1,197 cubic yards of sand filling in foundations, at $0.4303 per cubic yard	515.06
I-beams and channels	930.01
Flat tile arches for ceilings	850.76
Finishing face walls	415.82

Anchor bolts		$259.92
Purchase, construction, and installation of plant		5,749.81
Unloading carriages	$67.98	
Setting bedplates and racers	64.04	
Mounting carriages	176.02	
Unloading guns	58.09	
Mounting guns	290.75	
Cleaning, oiling, and painting guns and carriages	24.87	
		681.75
Waterproofing exterior walls (not completed)		269.67
Water supply		161.25
Drainage system (not completed)		47.50
Repairs and maintenance of plant		388.33
Installation of electric light and power plant (not completed)		388.74
Watching Government property		21.47
Time allowed employees for legal holidays		106.98
Repairs and maintenance of launch		94.84
Superintendence and office expenses		1,228.25
Total		44,181.23

Money statement.

March 18, 1898, amount allotted	$50,000.00	
April 1, 1898, additional allotment	24,000.00	
		$74,000.00
June 30, 1898, amount expended during fiscal year		43,210.31
July 1, 1898, balance unexpended		30,789.69
July 1, 1898, outstanding liabilities	$3,024.00	
July 1, 1898, amount covered by uncompleted informal contracts	8,300.00	
		11,324.00
July 1, 1898, balance available		19,465.69

Emplacements for two 12-inch B. L. rifles.—The approved project under which work is being carried on provides for the construction of two emplacements for 12-inch B. L. rifles on barbette nondisappearing carriages. The estimated cost of these two emplacements is $93,000. On April 25, 1898, a provisional allotment of $40,000 was made by the Chief of Engineers from the appropriation for "National Defense," act of March 9, 1898, to be applied to their construction with construction under item 1, Army Regulations, 566, authorized. On May 20, 1898, an additional allotment of $40,000 was made by the Chief of Engineers from the same appropriation.

The emplacements are situated one on each flank of the battery for two 8-inch disappearing guns. The plant used in building this battery was employed for the 12-inch emplacements.

Arrangements were made with the contractors who were furnishing construction materials for the mortar battery and the 8-inch battery to furnish and deliver the construction materials required, at the same prices and under the same requirements.

An agreement was also entered into with the Atlas Cement Company, New York, N. Y., to furnish and deliver, on or before June 19, 1898, about 1,250 barrels of Portland cement, "Atlas" brand, at $2.20 per barrel.

Excavation to reference 5 for the foundations was commenced on May 1 and completed on June 14, 1898, 550 cubic yards being removed for the foundations of the south emplacement and 780 cubic yards for those of the north emplacement, making a total of 1,330 cubic yards removed for the two emplacements. This material was all placed in the embankment in front of the battery.

Concrete construction was begun on the south emplacement on May 19, 1898. Up to the end of the fiscal year 2,732 cubic yards of Rosendale concrete and 10 cubic yards of Portland concrete had been placed in the parapet and magazines, and 547 cubic yards of Rosendale concrete and 159 cubic yards of Portland concrete had been placed in the platform. This was completed, with the exception of the asphalt pavement, ready for the carriage.

Concrete construction on the north emplacement was begun on June 8, 1898. Up to the end of the fiscal year 2,529 cubic yards of Rosendale concrete and 10 cubic yards of Portland concrete had been placed in the parapet and magazines, and 392 cubic yards of Rosendale concrete and 40 cubic yards of Portland concrete had been placed in the platform, making a total of 6,419 cubic yards of concrete placed for both emplacements out of a total of 10,700 cubic yards estimated.

Two hundred and twenty-one square yards of asphalt waterproof concrete were placed around and over the magazine of the south emplacement, at an average distance of 3 feet from the sides and ceilings, and 42 square yards for the north emplacement, the work being done under contract with W. S. P. Shields, Philadelphia, Pa.

Seven hundred and sixty-two cubic yards of sand filling had been placed in the sand core of the foundations of the south emplacement, and 986 cubic yards in the sand core of the foundations of the north emplacement, making a total of 1,748 cubic yards for the two emplacements. This sand was taken from the embankment at the mortar battery.

At the end of the fiscal year construction materials had been delivered for these emplacements as follows:

Portland cement	barrels	1,750
Rosendale cement	do	4,310
Small broken stone	cubic yards	6,040.01
Large broken stone	tons	1,133.36
Sand for concrete	cubic yards	2,380.63

Owing to delays in receiving the cement ordered for these emplacements, the supply of 3,300 barrels on hand at the mortar battery had to be used, as well as 1,500 barrels of the last load ordered for the 8-inch emplacements.

It is expected that all the concrete work of these emplacements will be completed by July 30, 1898. The guns and carriages will be mounted as soon as received.

Money statement.

April 25, 1898, amount allotted	$40,000.00	
May 20, 1898, additional allotment	40,000.00	
		$80,000.00
June 30, 1898, amount expended during the fiscal year		6,680.96
July 1, 1898, balance unexpended		73,319.04
July 1, 1898, outstanding liabilities	$21,149.21	
July 1, 1898, amount covered by uncompleted informal contracts	13,041.16	
		34,190.37
July 1, 1898, balance available		39,128.67

Emplacements for two 4.72-inch rapid-fire guns.—On April 6, 1898, a preliminary allotment of $6,000 was made from the appropriation for "National Defense," act of March 9, 1898, for the construction of emplacements for two 4.72-inch rapid-fire guns purchased abroad. In order to have these guns mounted and ready for service as speedily as possible it was decided to erect temporary platforms for them on the barbette

of the old fort. The work was begun on April 14, 1898, and completed on April 30, 1898. Special foundation bolts were purchased and anchored in the masonry of the fort; around them concrete platforms were built to a height 2 feet below the crest of the parapet; 24.5 cubic yards of concrete were used. The guns arrived on April 23, and were mounted in position by May 5, 1898. A supply of ammunition was received on May 6 and stored in adjacent magazines of the fort. The total cost of erecting the platforms and mounting the guns was $730.68.

On June 14, 1898, the Chief of Engineers approved a project for two permanent emplacements to take the place of the temporary platforms; their estimated cost is $19,000. On June 18 an additional sum of $13,750 was allotted for the construction of these emplacements from the appropriation for "National Defense."

The emplacements are located to the west of the fort, the crest being pushed as far to the front as the field of fire of the 12-inch guns of the proposed battery inside the fort will permit, remaining in the field of fire of the flank gun only when traversed more than 60 degrees to the west of the normal. In this position the two R. F. guns have a field of fire of nearly 300 degrees; the fort, the torpedo casemate, and one or two buildings on the island preventing them from having an all-around fire.

The emplacements have been designed with the object of reducing the concrete to the smallest amount consistent with affording good cover to the magazines and the requisite field of fire to the guns. The thicknesses of horizontal and vertical cover adopted by The Board of Engineers for the typical 5-inch R. F. emplacements have been closely followed. The crest has been placed as low reference 20 as is believed to be consistent with obtaining a good command. The entrances to the magazines open toward the fort, which covers them from hostile fire.

The battery, which has been made as light as practicable, is to be constructed on a pile and grillage foundation.

On June 22, 1898, the work of laying the necessary construction track to the site of the battery was begun, and at the end of the fiscal year this work had been completed, and a pile driver had been set up ready to begin driving the 206 piles required for the foundations.

The lumber and piles for the foundations had been ordered, and arrangements made for the purchase and delivery of the necessary construction materials.

A concrete mixer, complete with frame and trestle, and a double-drum hoisting engine for running the pile driver, had been transferred from another fort.

Money statement.

April 6, 1898, amount allotted	$6,000.00	
June 18, 1898, additional allotment	13,750.00	
		$19,750.00
June 30, 1898, amount expended during fiscal year		732.68
July 1, 1898, balance unexpended		19,017.32
July 1, 1898, outstanding liabilities	$289.24	
July 1, 1898, amount covered by uncompleted informal contracts	1,769.23	
		2,058.47
July 1, 1898, balance available		16,958.85

Submarine mines in the Delaware River, defenses of Philadelphia, Pa.—Before the beginning of the war the two mining casemates were roughly fitted up to be placed in full working order when the emergency arose. The torpedo material and apparatus on hand were overhauled and

placed in good condition; a loading room was fitted up in the cement storage shed near the fort and a pole line was run from it to the casemate; base lines were laid out to cover completely the various mine fields and charts were prepared for use in judgment firing. Sufficient dynamite to load one grand group of mines was purchased and stored in one of the magazines of the fort. Arrangements were made to have additional quantities of dynamite delivered as required on short notice alongside the fort wharf. Six miles of single and two miles of multiple cable, sufficient with the cable on hand to allow of the planting of three grand groups, were purchased. Everything was gotten in readiness, and all arrangements were made to begin the planting of mines as soon as the order was received. This order arrived on April 22, and on May 13, 1898, it was reported that the planting of three grand groups of mines—all for which the requisite materials were on hand—had been satisfactorily completed the day before. The work was delayed by storms; and the strong tidal currents made it more difficult than had been anticipated. The planting of the mines and the laying of the cables were done from a small lighter, having a steam derrick, lashed alongside the engineer tug *Delaware*. A naphtha launch, for the use of the engineer officer and for purposes of communication generally, and four rowboats for junction-box boats, were also employed. The force used was collected from various sources. The whole work was under charge of an engineer officer, who superintended personally all operations on the water. An assistant engineer, who had become thoroughly familiar with the torpedo system, was placed in charge of the casemate, and two former noncommissioned officers of engineers directed the operations of the loading room. The detail from Willets Point, consisting of a corporal and six privates, was used in the loading room and with the boat parties. Skilled linemen and jointers were obtained from Philadelphia, while laborers, riggers, carpenters, etc., were transferred temporarily from the works of fortification. Men sent down by the Bell Telephone Company, of Philadelphia, established telephonic communication between the casemate, loading room, and ends of the base line. They also laid a lead-covered cable in the river to the casemate on the Delaware shore. It was found not to be strong enough to stand the strong tidal currents and was soon taken up. Two tugs were hired as patrol boats and stationed one above and the other below the mine fields. They were on duty day and night to the end of the fiscal year, and secured a rigid enforcement of the regulations governing the passage of vessels past the mines. After the first two weeks little trouble was experienced in enforcing these regulations.

Two of the grand groups planted are in the main channel of the river and are operated from a mining casemate. The third group blocks the secondary channel, and is operated from another mining casemate. Both casemates are fully equipped with apparatus of the new design and are lighted by electricity. Tests to ascertain the condition of the mines are made and recorded daily. Two search lights are set up, one on the New Jersey side and one on the Delaware side. The latter is operated every night. A surveying party from the engineer office was present during the planting of the mines. They established ranges for locating the junction boxes and located each mine as planted. Its position was subsequently plotted on the specially prepared charts.

During May, 1898, it was found necessary to take up and destroy one mine from grand group No. 2, it having been struck and seriously

damaged by the propeller of some vessel. One mine of grand group No. 3 had its mooring rope broken, apparently by the action of the strong tidal currents. Two other mines of the same grand group became detached in June. All were picked up and stored away to be replanted.

The condition of the planted mines steadily deteriorated from the time of planting. On June 30, 1898, eleven out of the twenty-one triple groups could no longer be used for automatic firing, though they were still available for purely judgment firing. The ten remaining groups could still be fired either way, but the leaks shown in them were steadily growing worse. The tests also seem to indicate that several mines, in addition to those found floating, have had their electrical connection with the casemate broken.

The troops of the engineer detachment were frequently exercised in the judgment-firing drill. Guards were stationed at the casemates each night.

Money statement.

March 18, 1898, amount allotted	$1,500.00	
March 3, 1898, additional allotment	200.00	
April 4, 1898, additional allotm nt	3,000.00	
June 10, 1898, additional allotment	4,500.00	
June 16, 1898, additional allotment	8,500.00	
June 30, 1898, additional allotment	4,500.00	
		$22,200.00
June 30, 1898, amount expended during fiscal year		9,794.17
July 1, 1898, balance unexpended		12,405.83
July 1, 1898, outstanding liabilities	$2,810.85	
July 1, 1898, amount covered by uncompleted informal contracts	1,546.00	
		4,356.85
July 1, 1898, balance available		8,048.98

Rebuilding and enlarging dike at Fort Mifflin, Pa.—The river and harbor act of June 3, 1896, required the expenditure of $3,000, from the appropriation for improving Delaware River, upon this work.

Under date of October 7, 1896, contract was entered into with James J. Cowgill, of Paulsboro, N. J., for the required reconstruction and extension. Work under this contract was completed in December, 1896. The dike on the northeastern side of the reservation, extending from high ground at the old Lazaretto for a distance of 1,800 feet along the Schuylkill River front and an additional distance of 300 feet along the Delaware River front, was rebuilt and repaired. The top is now 10 feet above mean low water and has a width of 12 feet. The interior face has a slope of 1 on 2, and the stone revetment on the exterior slope has been relaid and raised to the full height of the dike.

During the past fiscal year $563.36, of the balance remaining available July 1, 1897, was expended in repairing 280 feet of dike along the Delaware River front by widening the top to 6 feet and relaying the face stone, in renewing a sluice through the short connecting bank between the main bank and the exterior battery of the fort, and in stopping leaks in the main bank.

Money statement.

July 1, 1897, balance unexpended	$571.60
June 30, 1898, amount expended during fiscal year	563.36
July 1, 1898, balance unexpended	8.24

4 G.

DEFENSES OF BALTIMORE, MARYLAND.

Officer in charge, Brig. Gen. Peter C. Hains, U. S. Volunteers, Colonel, Corps of Engineers, with Lieut. Charles W. Kutz, Corps of Engineers, as assistant until October 22, 1897, and from April 1, 1898, to June 10, 1898; during the remaining portions of the fiscal year they were in the temporary charge of Lieut. Charles W. Kutz, Corps of Engineers.

Fort McHenry, Md.—The fortifications at this place were commenced in 1775, and in 1794 the existing work was built.

Although the old fort has become almost useless as a defensive work against naval attack, the site is still an important one and needed for other purposes.

There were no operations during the fiscal year, except those of preparation for certain repairs to be done with funds from the appropriation for preservation and repair of fortifications.

Money statement.

July 1, 1897, balance unexpended		$5,663.91
April 16, 1898, transferred to another work	$3,000.00	
June 30, 1898, amount expended during fiscal year	620.40	
		3,620.40
July 1, 1898, balance unexpended		2,043.51

Emplacements for one 12-inch and three 8-inch rifles.—The project and plans for the battery were submitted October 28, 1896, and approved October 29, 1896. This work was done under a contract with Jones, Pollard & Co., dated December 23, 1896. Actual work was begun in January, 1897, and completed June 30, 1898. The contract expired September 23, 1897, but was twice extended.

This battery is of the half-sunken type, with the crest held at reference 41.5 feet above mean low water, the general reference of the ground being 30 feet above the same datum.

The 8-inch guns face due east, while the crest of the 12-inch gun is withdrawn at an angle of 42° 30′. As a protection against enfilade fire the magazines and shot rooms were placed forward of the interior crest line instead of in the traverses, and the loading passages were protected by an embankment of earth sloping toward the sunken roadway in rear.

Two wells were placed in rear of each emplacement to receive cranes for ammunition service. A third crane is placed in the open passage connecting the sunken roadway with the loading passage. The forward portion of each traverse is of solid concrete and the rear portion of earth, with a small storeroom beneath it.

A double-car, flush-deck elevator was placed on the loading platform of the 12-inch gun for the service of ammunition. It is arranged for both electric and hand power. It is fitted with safety clutches at each corner and provided with automatic terminal stops.

The battery is lighted by electricity. In the magazines and shot rooms the lights were placed in recesses in the walls, behind heavy plate glass held in brass frames, the controlling switches being placed outside of the rooms. The power plant which is used for lighting the battery consists of a 10-kilowatt direct-connected unit wound for 110 volts and supplemented by a booster and a storage battery, the latter capable of operating all the lights in the battery for a period of five hours.

The power house is located on the left flank of the battery, and is well protected against the fire of an enemy. It is of ample size and, being open to the rear, is always well ventilated.

At the close of the last fiscal year the contractors had practically completed the wharf, excavated 13,681 cubic yards of material and deposited it in the parapet, and laid 1,682 cubic yards of concrete. Since then work has been carried on continuously, except during the months of January and February, 1898, when severe weather necessitated a stoppage. During March, April, and May work was carried on day and night. Two of the 8-inch platforms were completed December 20, 1897; the third 8 inch platform and the 12-inch platform were completed in March, 1898.

The principal items of work were:

Excavation—	
Common, 31,253 cubic yards, at 32 cents	$10,000.86
Hardpan, 545 cubic yards, at 36 cents	196.20
Concrete—	
No. 1, 14,986 cubic yards, at $4.35	65,189.10
No. 2, 1,148 cubic yards, at $7.15	8,208.20
Grading, 19,000 cubic yards, at 19 cents	3,610.00

The total cost of the battery, including superintendence, amounted to $143,800.

The armament was delivered by the quartermaster on the wharf, distant 900 feet from the battery. The three 8-inch guns and carriages were moved to a position in front of the battery at a cost of $692.24, the work being done by contract. They were mounted by hired labor at a cost of $1,200. The 12-inch gun and carriage were moved from the wharf and mounted at a cost of $2,000, the work being done by hired labor.

The site of the battery, which was being seriously injured by erosion, was partially protected by the deposit along the shore line of 3,049 cubic yards of riprap, and placing 4,476 cubic yards of oyster shell and earth fill behind it, at a cost of $6,645.41, the funds being derived from the appropriation for "Preservation and Repair of Fortifications."

The funds for building the battery were derived from allotments from the appropriation for "Gun and Mortar Batteries," act of March 3, 1897, except $5,500, which was allotted from the appropriation of June 6, 1896.

Money statements.

GUN AND MORTAR BATTERIES.

July 1, 1897, balance unexpended	$130,828.54
June 30, 1898, amount expended during fiscal year	102,537.14
July 1, 1898, balance unexpended	28,291.40
July 1, 1898, outstanding liabilities	28,291.40

MOUNTING GUNS AND CARRIAGES.

Allotments	$3,200.00
June 30, 1898, amount expended during fiscal year	3,190.34
July 1, 1898, balance unexpended	9.66
July 1, 1898, outstanding liabilities	9.66

PRESERVATION AND REPAIR OF FORTIFICATIONS.

Shore protection.

July 1, 1897, balance unexpended	$7,000.00
June 30, 1898, amount expended during fiscal year	6,749.91
July 1, 1898, balance unexpended	250.09

Abstract of proposals for moving one 8-inch gun carriage and three 8-inch guns from the wharf to site of the gun battery; opened at the United States Engineer Office, Baltimore, Md., at noon, January 3, 1898.

No.	Name and address of bidder.	Amount.
1	Wm. H. Brown, Baltimore, Md	$641.00
2	Louis E. Broom, Baltimore, Md	400.00
3	James McC. Gibson, Baltimore, Md	836.00

Contract with Louis E. Broom.

Contracts in force during the fiscal year.

With Jones, Pollard & Co. for building a gun battery, approved January 5, 1897, commenced in January, 1897, and was completed June 30, 1898; with Louis E. Broom for moving ordnance, approved January 21, 1898, commenced in January, 1898, and was completed January 25, 1898.

Emplacements for two 4.7-inch R. F. guns.—The construction of these emplacements was authorized by the Chief of Engineers in letter dated March 19, 1898. The work was done, under an oral agreement, by Jones, Pollard & Co., the contractors for the 8-inch and 12-inch gun battery. It was commenced April 2, 1898, and practically completed May 10, 1898.

The platforms are not entirely finished, a well having been left to permit the setting of the foundation bolts on the arrival of the carriages. The earthen parapet is also incomplete, and the slopes are not sodded. This work is, however, in progress, and will be completed during the ensuing month.

The crest of this battery is in prolongation of that of the 8-inch gun battery, and is held at the same reference. Owing to the limited area of the site, the guns were placed only 36 feet apart instead of 45 feet, as specified by The Board of Engineers for 5-inch gun batteries, and a single magazine was built for the two guns.

The mass of the concrete, known as No. 1, was mixed in the proportions of 1, 2, and 4, natural cement being used. The exposed surfaces were faced with 6 inches of granolithic concrete, placed and rammed with the No. 1 concrete. This was mixed in the proportions of 1, 1½, and 2, Portland cement being used, and the stone of such size as to pass through a half-inch ring. Plans have been prepared for an ammunition hoist for this battery, and it is proposed to install it in the near future.

The principal items of work completed to date are—

981 cubic yards concrete No. 1, at $5.06	$4,963.86
89 cubic yards concrete No. 2, at $12	1,068.00
1,513 cubic yards excavation, at 35 cents	529.55
1,596 pounds iron bridge, at 8 cents	127.68

Funds were derived from the allotment from the appropriation for "National Defense," act March 9, 1898.

Money statement.

Allotments	$15,000.00
June 30, 1898, amount expended during fiscal year	7,592.70
July 1, 1898, balance unexpended	7,407.30
July 1, 1898, outstanding liabilities	1,000.00
July 1, 1898, balance available	6,407.30

Battery for eight 12-inch B. L. mortars.—The project and plans for the battery were submitted September 19, 1896, and approved September

23, 1896. The work was done under a contract with Sanford & Brooks, dated November 7, 1896. Actual work was begun December 10, 1896, and completed June 30, 1898. The contract expired October 1, 1897, but was twice extended.

The battery is of the rectilinear type, with the crest held at an elevation of 42 feet above mean low water, the level of the ground varying from 7 feet to 16 feet above the same datum. The two pits are 120 feet apart, and open to the rear. The magazines and shell rooms are placed in front of the pits and are accessible by means of a longitudinal passage in the traverse.

To secure a good foundation for the platforms it became necessary to carry the concrete work down to a point 4.6 feet below the plane of mean low water. The platforms are built entirely of Portland cement concrete, and no settlement whatever is discernible.

The walls surrounding magazines, shell rooms, and passages are built of natural cement concrete, faced with 6 inches of granolithic concrete. The front part of the parapet is built of common sand, while the traverse and flanks are built of earth. Air spaces were not built around the magazines. As a precaution against leakage the top surface of the concrete was laid with decided slopes, and then coated with alternate washes of soap and alum in saturated solutions. Six coats of each were applied. A 3-inch tile drain covered with broken stone, was laid around the foundations of the walls and only good sand was back filled against the concrete.

The magazines, which are kept constantly closed, are dry, but the shell rooms and passages are wet, and the moisture is thought to be entirely due to condensation. Recesses for electric blowers, with the necessary inlet and outlet pipes, were left in the walls, and their installation is expected to dry up much of the existing moisture. A powder car, running on an overhead tramrail, was placed in the longitudinal passage. It has room for eight charges of powder, and will expedite the delivery of powder from the magazines to the trucks. A powerhouse was built in the rear portion of the traverse. It is intended to contain all the electric plant that will be required for the batteries at this place.

The lighting of this battery by electricity was not provided for in Sanford & Brooks's contract. Specifications covering this work were issued June 3, 1898, and a contract has been entered into with the Ellicott Machine Company, but it has not yet been approved by the Chief of Engineers.

At the close of the last fiscal year the contractors had completed the wharf, excavated 6,591 cubic yards of material and deposited it in the parapet, and laid 1,403 cubic yards of concrete. Since then work has been carried on continuously except during the months of January and February, 1898, when severe weather interfered. The length of time occupied in building this battery was mainly due to the lack of proper plant. The contractor mixed all his concrete by hand, and much of it was carried from the mixing boards to its place of deposit in wheelbarrows.

The principal items of work were:

Excavation, 8,248 cubic yards, at 55 cents	$4,536.40
Fill brought to the reservation:	
Earth, 34,826 cubic yards, at 29 cents	10,099.54
Sand, 30,095 cubic yards, at 45 cents	13,542.75
Concrete No. 1, 6,441 cubic yards, at $4.73	30,465.93
Concrete No. 2, 1,010 cubic yards, at $6.54	6,605.40
Concrete No. 3, 815 cubic yards, at $8.73	7,114.95

The total cost of the battery, including superintendence, amounted to $113,000.

The armament was delivered by the quartermaster on the wharf, distant 2,000 feet from the battery. The carriages arrived prior to the completion of the battery and were stored on the reservation, a wooden shed having been built for the protection of the smaller parts. The cost of moving them from the wharf and storing them amounted to $829.57, in which is included the cost of the shed. From the place of storage they were taken to the battery and mounted at a cost of $2,052.94. The mortars were moved from the wharf and mounted at a cost of $640.46. This work was all done by the contractors for the battery under the supervision of this office, and paid for as an item under paragraph 66 of the specifications governing their contract.

The funds for building the battery were derived from the appropriation for "Gun and Mortar Batteries," acts of June 6, 1896, and March 3, 1897.

Money statement.

July 1, 1897, balance unexpended	$103,793.94
June 2, 1898, withdrawn	6,900.00
	96,893.94
June 30, 1898, amount expended during fiscal year	77,631.71
July 1, 1898, balance unexpended	19,262.23
July 1, 1898, outstanding liabilities	16,867.54
July 1, 1898, balance available	2,394.69

Appropriation, "National Defense," act March 9, 1898. Abstract of proposal for an electric-power plant, opened at the United States Engineer Office, Baltimore, Md., at noon, June 13, 1898.

No.	Name and address of bidder.	Amount.	Remarks.
1	Southern Electric Co., Baltimore, Md.	$3,900	Using Westinghouse Junior automatic engine.
		4,000	Using Westinghouse Standard automatic engine.
2	Wallace Stebbins, Baltimore, Md.	4,678	
3	McCay Engineering Co., Baltimore, Md.	3,943	
4	Ellicott Machine Co., Baltimore, Md.	2,995	Will install plant so that it can be operated from present generator in 20 days.
		2,820	
5	Lazenby & Pender, Baltimore, Md.	3,260	

Contract with Ellicott Machine Company.

CONTRACT IN FORCE DURING THE FISCAL YEAR.

With Sanford & Brooks for building a mortar battery, approved November 12, 1896, commenced in December, 1896, and completed June 30, 1898.

Emplacements for two 5-inch rapid-fire guns.—The project and plans for the battery were submitted May 1, 1897, and approved May 11, 1897. The work was done under a contract with Jones, Pollard & Co., dated July 31, 1897. Actual work was begun August 10, 1897, and completed June 1, 1898. The contract expired January 1, 1898, but was extended.

The emplacements are arranged for balanced-pillar mounts, and the direction of fire is such that both guns will cover the mine field. The crest is held at reference 26.5 above mean low water, and the guns are spaced 56 feet 6 inches between centers. The platforms are on the same general level as the roadway in rear; the magazine floors are 7 feet 6

inches lower. The magazines are accessible by means of a flight of concrete steps leading from the roadway in rear to a small areaway in rear of the magazine doors. A link-belt ammunition hoist is provided for each emplacement; they are placed in the small areaway above referred to.

Owing to its proximity to a rapidly eroding bluff the battery was protected by means of a line of riprap stone, so placed that it would also serve as a foundation for a sea wall. Five thousand cubic yards of earth were brought to the reservation and placed in rear of this riprap as a further protection. The battery is built of natural cement concrete mixed in the proportions of 1, 2, and 4, and all exposed surfaces are faced with 6 inches of granolithic concrete.

The battery is finished with the exception of the platforms, which must remain incomplete until the arrival of the carriages.

The principal items of work in the construction of the battery did not differ materially from the estimated quantities as shown in the abstract of bids.

The total cost of the battery, including superintendence and inspection, was $14,964.28.

The funds were derived from the appropriation for "Gun and Mortar Batteries," act March 3, 1897.

Money statement.

Allotments		$17,400.00
June 30, 1898, amount expended during fiscal year		14,964.28
July 1, 1898, balance unexpended		2,435.72
July 1, 1898, outstanding liabilities	$1,000.00	
July 1, 1898, amount covered by uncompleted contracts	1,000.00	
		2,000.00
July 1, 1898, balance available		435.72

Abstract of proposals for building a rapid-fire gun battery, opened at United States Engineer Office, Baltimore, Md., at noon, July 12, 1897.

Materials all in place.	Approximate quantities.	Name and address of bidder.			
		No. 1—Jones, Pollard & Co., Baltimore, Md.		No. 2—Sanford & Brooks, Baltimore, Md.	
		Price.	Total.	Price.	Total.
Artesian wells per foot ... feet	300	$3.08	$924.00	$4.00	$1,200.00
Ammunition hoists ... number	2	238.40	476.80	300.00	600.00
Broken stone for blind drains ... cubic yards	30	1.98	59.40	2.00	60.00
Brass fittings for doors ... pounds	100	.49	49.00	1.00	100.00
Concrete masonry No. 1 ... cubic yards	1,200	4.92	5,004.00	5.50	6,600.00
Concrete masonry No. 2 ... do	150	7.68	1,152.00	9.00	1,350.00
Culvert pipe, 6-inch ... linear feet	250	.16 4/10	40.50	.50	125.00
Excavation ... cubic yards	700	.42	294.00	.40	280.00
Fencing ... linear feet	2,700	.20 8/10	564.30	.20	540.00
Fill, earth ... cubic yards	5,000	.63	3,150.00	.60	3,000.00
Fill, common sand ... do	1,700	.67	1,139.00	.60	1,020.00
Frames and covers for manholes and sumps, cast iron ... pounds	150	.04 4/10	6.30	.05	7.50
Ladders, wrought iron ... do	120	.06	7.20	.05	6.00
Loam ... cubic yards	450	.58	261.00	.70	315.00
Lumber for doors and electric-light strips ... feet B. M.	350	.12 8/10	44.80	.06	21.00
Porous drain tiles, 2-inch ... linear feet	300	.13 8/10	41.40	.10	30.00
Riprap stone ... cubic yards	600	1.95	1,170.00	2.00	1,200.00
Sod ... square yards	1,300	.39 6/10	514.80	.45	585.00
Grand total			15,798.50		17,039.50

Contract awarded to Jones, Pollard & Co.

CONTRACT IN FORCE DURING THE FISCAL YEAR.

With Jones, Pollard & Co., for building a gun battery; approved August 12, 1897; commenced August 10, 1897, and completed June 1, 1898.

Emplacements for two 12-inch B. L. rifles on disappearing carriages.—The construction of these emplacements was authorized by the Chief of Engineers in letter dated March 19, 1898. The work was done by hired labor and the purchase of material in open market.

These emplacements form the left half of a four-gun battery designed for this place. Owing, however, to the improbability of work being undertaken on the remaining emplacements very soon, both were built as flank emplacements, one right and one left. To maintain the requisite protection on the exposed flank, it became necessary to increase the typical distance between gun-centers 135 feet to 150 feet. The overhead cover and front cover are as specified by The Board of Engineers.

The crest is held at elevation 34 above mean low water, the general reference of the ground being 19. The original intention was to hold the crest at 32, but as that carried the foundations through a bed of sand into a layer of blue clay, the change was made.

The relative arrangement of magazines, shot rooms, and passages, as shown on the type plans, was modified for two reasons; first, for the sake of simplicity; second, because local conditions did not demand the same protection against flank and partial reverse fire. To insure the magazines against the infiltration of moisture the concrete above them was crowned, the rise being 4 feet. The sloping sides were then covered with a layer of hollow brick so laid that the ducts lead directly to the 3-inch air space surrounding the magazines, and provision was made for draining the air spaces. So far there has not been the slightest indication of moisture either in roof or walls.

Plant: There was practically no plant on hand when the construction of this battery was authorized. Owing to the necessity for rapid work a much larger plant was purchased than ordinary conditions would have justified.

The pierhead of the existing wharf was enlarged at a cost of $1,621.90. Two stiff leg derricks, each operated by a 20-horsepower Lidgerwood engine, were placed on it and a half mile of narrow-gauge track laid thence to the site of the battery. The rolling stock consisted of a 13-ton locomotive, 12 side-dumping cars, 6 flat cars, and 2 hopper cars. The stone and sand were stored in wooden bins having a capacity of 1,500 cubic yards. They were made large to provide against irregularities in the delivery of materials, and subsequent events justified the cost of their construction. The concrete-mixing plant consisted of two 5-foot cube mixers with hollow axles for admitting water, manufactured by Thomas Carlin's Sons, each of which was operated by an independent Struthers, Wells & Co. engine with a capacity of 20 horsepower; a third engine, double drum and double cylinder, was used to haul the raw materials from the subbin railway up a 30° incline to the platform above the mixers. These three engines were fed by a 60-horsepower vertical boiler. The mixers were made independent of each other, in order that an accident to one might not stop the other. Two wrought-iron pipe derricks with 75 foot booms and two wooden derricks with 55-foot booms were so placed as to cover the entire work. The concrete when mixed was dropped into wooden skips resting on small flat cars and hauled to the derricks by a mule. A 15-kilowatts Westinghouse generator belt, connected to an Atlas engine, and a 40-horsepower boiler were purchased as part of the permanent power plant of the battery.

They were used during the construction of the battery to operate a circuit of 10 arc lights, thus greatly facilitating night work.

Water supply: To secure an adequate supply of water for the boilers, as well as the mixers, an artesian well was sunk near the battery. The operation was so slow, however, that the battery was half completed before the well could be used. Pending the completion of the well, water for the boilers had to be hauled from a surface well half a mile distant, and the water used in the concrete was pumped up from the bay. The total depth of the well is 315 feet. For a depth of 250 feet 6-inch pipe was used. A bed of very fine sand prevented its being driven deeper, and it became necessary to double line the well, using 4-inch pipe. The water obtained from this well carries with it a considerable quantity of very fine sand, which makes it objectionable for drinking purposes, but it is gradually clearing. Its flow is about 25 gallons per minute.

Construction of the battery: The delivery of the plant was not made until the latter part of April, and it was not completely installed until May 9, 1898. During the erection of the plant the necessary excavation for the battery was made and the platforms built with hand-mixed concrete. One platform was completed April 30 and the other May 10, 1898. From May 9 until June 20 work was carried on day and night. Two forces were employed, each working ten hours. With the exception of 300 cubic yards of concrete the masonry work was finished June 30.

The rear wall of the loading passage and all the small division walls were built of brick. A granite coping was placed on the rear edge of the loading platform and granite lintels over the doors on the rear face. The concrete in the platforms was mixed in the proportions of 1, 2, and 4, Atlas Portland cement being used. For the mass of the work the proportions were made 1, 2½, and 5. To keep the work going it was necessary to purchase whatever cement could be found in the market. Much the largest part of it, however, about 11,000 barrels, was obtained from the Maryland Cement Company, and is commercially known as slag cement. Its tensile strength on short period tests is nearly equal to that of Portland cement, while its cost is not much greater than that of natural rock cement. It showed a decided tendency to check and crack when subjected to the pat test (mixed neat), unless the pat was carefully protected by a damp cloth while drying. When mixed in the form of concrete, however, no cracks were detected. The results obtained by its use are so far very satisfactory, though there is a possibility that it may deteriorate with the lapse of time.

It is impossible at this time to transmit a tabulated statement of the cost of the work in detail. The necessary data are on hand, but owing to more important work their tabulation is postponed.

The principal items of work to June 30 are as follows:

Excavation	cubic yards	8,555
Brick	number	275,000
Concrete	cubic yards	11,875
I-beams	pounds	82,472
Corrugated roofing	do	19,958

The funds were derived from the appropriation for "National Defense," act March 9, 1898.

Money statement.

Allotments	$100,000.00
June 30, 1898, amount expended during fiscal year	73,798.92
July 1, 1898, balance unexpended	26,201.08
July 1, 1898, outstanding liabilities	26,201.08

Emplacements for two 12-inch B. L. rifles on barbette carriages.—The construction of these emplacements was authorized by the Chief of Engineers in letter dated April 25, 1898, and afterwards modified, as to location, in a telegram dated April 29, 1898. The work is being done by the hire of labor and the purchase of material in open market.

The character of the site necessitated a number of modifications in the type plans. Its limited area reduced the distance between gun centers to 125 feet, and necessitated the placing of the magazines for both guns in the central traverse, with a consequent reduction in storage capacity. The crest of the battery is held at reference 23.5 above mean low water, while the magazine floors could not be placed below reference 6 owing to danger of flooding during exceptionally high tides. Allowing 8 feet of headroom in the magazines, the overhead cover was thus reduced to 9 feet. To compensate for this reduction steel plates 1½ inches thick will be embedded in the concrete, and so placed as to cover the entire magazine area. The front cover conforms to that specified on the type plans.

Plant: The plant used in construction consists of a stiff-leg derrick for unloading material from scows into the storage bins, a small cable way which carries it thence to feed bins over the mixer, a 5-foot cube concrete mixer, and a cable way for carrying the mixed concrete to two stiff-leg derricks with 50-foot booms, which are used in placing it. A guy derrick in rear is used for handling the granite blocks used in the battery as deflectors and for the building of the rear wall, which is also of granite.

There was a large quantity of granite on hand prior to the construction of these emplacements, and about 2,000 cubic yards of it rested on the battery site. Pending the erection of the steam plant concrete was mixed and placed by hand. No. 1 platform was built in this way and completed by June 1. No. 2 platform was completed June 15. At the end of the fiscal year about 2,500 cubic yards of concrete had been mixed and placed. It is expected that the work will be completed within two months.

The funds were derived from the appropriation for "National Defense," act March 9, 1898.

Money statement.

Allotments	$80,000.00
June 30, 1898, amount expended during fiscal year	8,093.15
July 1, 1898, balance unexpended	71,906.85
July 1, 1898, outstanding liabilities	35,000.00
July 1, 1898, balance available	36,906.85

Rock Point, Margland.—This site is in the care of a watchman. Operations were confined to the construction of a temporary wharf, marking the boundaries with concrete monuments, and inclosing the property with a Page wire fence.

The funds were derived from the appropriation for "Preservation and Repair of Fortifications," act March 3, 1897.

Money statement.

July 1, 1897, balance unexpended	$1,400.00
June 30, 1898, amount expended during fiscal year	1,303.25
July 1, 1898, balance unexpended	96.75

4 H.

DEFENSES OF WASHINGTON, DISTRICT OF COLUMBIA.

Officer in charge, Lieut. Col. Charles J. Allen, Corps of Engineers; assistant, Maj. Jay J. Morrow, U. S. Volunteers, Lieutenant, Corps of Engineers.

Gun and mortar batteries.—The progress and general condition of the work at the close of the fiscal year ended June 30, 1897, were as follows:

Battery B, for two 10-inch guns on disappearing carriages, had been completed, and the guns were mounted. The south emplacement of Battery C, for a 10-inch gun, had been completed as far as practicable until completion of the north emplacement, and the gun mounted. The north emplacement had been commenced under an allotment of $41,500, made May 17, 1898. Repairs to the wharf which were necessary to proper handling of material for the new work had begun. Soil had been stripped from the site of the north emplacement and excavation was under way.

WORK OF THE PAST FISCAL YEAR.

The repairs to the wharf, which were completed during July, consisted in entirely replacing the wharf head above low-water line.

Concrete work was greatly delayed by failure of the contractor for furnishing natural cement to deliver cement of required strength, and by failure of the contractor for furnishing broken stone to deliver that material as required. It became necessary to annul both of these contracts. Concrete work was, however, begun in September on the north emplacement of Battery C and continued, with interruptions from the causes mentioned, until completed about January 1. The 10-inch gun for this emplacement was mounted in March last, by Battery A, Fourth Artillery. Excavation to the plane of depressed fire in front of the parapet was completed in June, a large part of the earth excavated being placed in the earth parapet. The soil covering of the earth parapet was placed during the fiscal year and machinery installed so that the gun was in condition to be well served as soon as mounted. During April and May a concrete room for electric light and power plant was built in rear of and adjoining the left emplacement of the battery. This battery was practically completed during the year, some minor work of spreading soil on slopes of roadway, erecting railings and steps, and a few small items of work being all that remains to complete the north emplacement.

The work for construction has all been done by hired labor.

Money statement.

July 1, 1897, balance unexpended	$42,634.66
June 30, 1898, amount expended during fiscal year	40,466.35
July 1, 1898, balance unexpended	2,168.31
July 1, 1898, outstanding liabilities	1,572.00
July 1, 1898, balance available	596.31

Cable storage tanks.—At the close of the fiscal year ending June 30, 1897, the concrete work of these tanks had been completed, the framework of the shed had been erected, and part of the sheathing placed.

During the fiscal year the work was completed, except the grading of the roadway in front. This was interfered with partly by the use of

the roadway for storage of materials used in construction of the torpedo storehouse, and partly by use of the covering shed in connection with submarine mines.

This work was done by hired labor.

Money statement.

July 1, 1897, balance unexpended	$3,351.22
June 30, 1898, amount expended during fiscal year	3,124.80
July 1, 1898, balance unexpended	226.42
July 1, 1898, outstanding liabilities	6.00
July 1, 1898, balance available	220.42

Quarters for engineer employees.—Under date of August 27, 1897, the repair of an old farmhouse on the reservation and the construction of a small office building and three temporary buildings for quarters for employees were authorized by the Chief of Engineers. This work was begun in September, and all buildings were completed and occupied by December following, three buildings formerly occupied for engineer purposes having been vacated and turned over to the commanding officer of the post.

This work was done by hired labor.

Money statement.

Amount of allotments	$2,900.00
June 30, 1898, amount expended during the year	2,900.00

Storehouse for submarine mine material.—Under date of September 8, 1897, an allotment of $4,300 was received for construction of a brick storehouse for storage of submarine mine material. This was increased by further allotment of $600, under date of October 8. Work was begun in November, in which month the foundation walls and sand filling were completed. Freezing weather prevented further construction until April, 1898, when work was resumed. At the end of the fiscal year the walls and roof had been completed.

This work was done by hired labor.

Money statement.

Amount of allotments	$4,900.00
June 30, 1898, amount expended during fiscal year	2,939.78
July 1, 1898, balance unexpended	1,960.22
July 1, 1898, outstanding liabilities	347.00
July 1, 1898, balance available	1,613.22

Experimental parapets.—Under date of October 29, 1897, an allotment of $18,550 was received for construction of experimental parapets, shield, and platform, and parapet for gun. This was increased by further allotment of $1,700 received June 8, 1898. Construction was begun in December, the first concrete being laid December 21. The concrete and steel work for Parapet B was completed February 10, 1897, the concrete work of Parapet A on February 21, 1897, concrete work of platform February 24. Work on crib work for shield and for gun parapet, and excavation and fill for same were continued throughout the winter and spring until completion in June. During the fiscal year the work was completed except some bracing for shield, the completion of the thin screen to register hits from fragments, and sodding of the two parapets.

This work was done by hired labor.

Money statement.

Amount of allotments	$20,250.00
June 30, 1898, amount expended during fiscal year	16,989.48
July 1, 1898, balance unexpended	3,260.52
July 1, 1898, outstanding liabilities	2,585.00
July 1, 1898, balance available	675.52

PRESERVATION AND REPAIR.

During the fiscal year the following operations were undertaken under the various allotments.

Repairs to mining casemate.—The work of waterproofing this casemate, which was built about 1891, was begun in September, 1897. During that month and October the necessary work of excavating to uncover the concrete work was completed. The walls were then painted on the outside with tar and pitch and the roof was asphalted, which work was completed in December. After laying the necessary drainage pipes the back fill was cained to the level of the top of the concrete work, it being intended to allow it to so remain until it should be known whether or not the work was entirely successful. Upon the breaking out of war in April it became necessary to protect the casemate against possible breach by partly completing the back fill. This was done, though not to the original lines of earthwork.

Parapet for 15-inch guns.—Upon breaking out of war in April it was regarded as necessary to strengthen the parapet in front of 15-inch guns. The thickness of the parapet was increased to about 25 feet, and the earth retained in place by a revetment of logs and gabions. This work was done by hired labor and completed during May.

Field magazine for 15-inch gun.—A temporary magazine was fitted up from an existing old magazine. This work was almost completed during the fiscal year.

Dismounting two 15-inch guns.—Under date of May 27 an allotment of $175 was received for dismounting two of the 15-inch guns and hauling the carriages thereof to the wharf for shipment. This work was completed and the carriages shipped during June.

Minor work of preservation and repair.—Occasional slight repairs were made to lower wharf. Cisterns were cleaned when necessary, repairs were made to the pump, to the deep-driven well, and grass and weeds were cut when necessary. A slight hedge was planted in front of the concrete work of Battery B to conceal the bright white surface from view from the river. Slight repairs were also made to granolithic work, doors, etc., due to damage from blast in firing the guns at Battery B.

All work under these allotments was done by hired labor.

Money statement.

July 1, 1897, balance unexpended	$5,733.75
Allotment during year	175.00
	5,908.75
June 30, 1898, amount expended during fiscal year	3,667.78
July 1, 1898, balance unexpended	2,240.97
July 1, 1898, outstanding liabilities	298.00
July 1, 1898, balance available	1,942.97

Telephone booths.—Under date of May 7, 1898, an allotment of $160 was received for construction of telephone booths for use in connection with service of the guns. The work was completed and the booths set in place during the fiscal year by hired labor.

Money statement.

Amount of allotment	$160.00
June 30, 1898, amount expended during fiscal year	140.91
July 1, 1898, balance unexpended	19.09
July 1, 1898, outstanding liabilities	19.09

Observation stations and plotting house.—Under date of May 6, 1898, an allotment of $350 was received for constructing two observation stations and plotting house for use of artillery in position finding. The work was completed during the fiscal year, being done by hired labor.

Money statement.

Amount of allotment	$350.00
June 30, 1898, amount expended during fiscal year	350.00

Electric-light plant.—Under date of April 6, 1898, an allotment of $8,250 from the appropriation for "Gun and Mortar Batteries" (by contract), act of March 3, 1897, was received for an electric-light and power plant. Sealed proposals for the work were invited. Bids were opened in April, but, no satisfactory bids being received, all were rejected and the work was readvertised, the proposals being opened June 3, 1898. Work was awarded to L. W. Woolston & Co., they being the lowest bidders.

Money statement.

Amount of allotment (available July 1, 1898)	$8,250.00

The following is a report of operations under the appropriation for "National Defense," act of March 9, 1898:

Battery D.—Under date of March 18, 1898, an allotment of $50,000 was received for beginning construction of a battery of two 10-inch guns on disappearing carriages. This was increased by further allotment of $42,300 under date of June 11. Work was begun March 21. Clearing was completed and part of railroad built during March. During April the plant was assembled, quarters for employees were built, and concrete work was begun, the two platforms being completed ready for their guns on April 13 and 14, respectively. Concrete work progressed rapidly, being over two-thirds completed at the close of the fiscal year. The excavation in front to the plane of depressed fire had also advanced. This work was done by hired labor.

Money statement.

Amount of allotments	$92,300.00
June 30, 1898, amount expended during fiscal year	37,540.83
July 1, 1898, balance unexpended	54,759.17
July 1, 1898, outstanding liabilities	23,583.00
July 1, 1898, balance available	31,176.17

Rapid-fire battery.—Under date of May 3, 1898, an allotment of $6,000 was received for beginning the construction of a battery for two 4-inch Driggs-Schroeder rapid-fire guns. This was increased by further allotment of $7,150, under date of June 11. Work was begun in May. An old magazine was destroyed and removed, and about 300 cubic yards of concrete placed, mostly in June. At the close of the fiscal year the

concrete in floors of both magazines and about half that in the walls of one magazine had been placed in addition to the concrete in the two platforms. Both guns were in process of mounting. This work was done by hired labor.

Money statement.

Amount of all allotments	$13,150.00
June 30, 1898, amount expended during fiscal year	1,945.22
July 1, 1898, balance unexpended	11,204.78
July 1, 1898, outstanding liabilities	5,141.00
July 1, 1898, balance available	6,063.78

Artillery defense.—Under date of April 23, 1898, an allotment of $500 was received for artillery defense. This was expended during the fiscal year in purchase of some equipage, painting of concrete surface of emplacements, and in clearing in front of the guns in some places. The work was done by hired labor.

Money statement.

Amount of allotment	$500.00
June 30, 1898, amount expended during fiscal year	496.30
July 1, 1898, balance unexpended	3.70
July 1, 1898, outstanding liabilities	3.70

Mounting 10-inch gun on barbette.—Under date of April 15 an allotment of $1,600 was received for mounting for defense the 10-inch gun and carriage sent for experimental firing. This was further increased by an allotment of $150 under date of June 8. The platform of concrete was constructed early in May. The gun and carriage were hauled from the wharf to the site and mounted, the artillery garrison being unable to devote much time to that work. The gun was in position for defense on May 25. During the fiscal year the work was completed by the construction of a slight earth parapet with gabion revetment. This work was done by hired labor.

Money statement.

Amount of allotment	$1,750.00
June 30, 1898, amount expended during fiscal year	785.23
July 1, 1898, balance unexpended	964.77
July 1, 1898, outstanding liabilities	583.00
July 1, 1898, balance available	381.77

Abstract of proposals for American natural cement, opened July 6, 1897, by Lieut. Col. Charles J. Allen, Corps of Engineers, United States Army.

No.	Name and address of bidder.	4,800 barrels, in barrels.		4,800 barrels, in bags.	
		Per barrel.	Amount.	Per barrel.	Amount.
		Cents.		*Cents.*	
1	Lawrenceville Cement Co., New York, N. Y.	72	$3,456	65	$3,120
2	New York and Rosendale Cement Co., New York, N. Y.	79	3,792	.....	.....
3	H. A. Jones & Co., Washington, D. C.	81	3,888	61	2,928
4	B. Wallis & Co., Baltimore, Md.	* 87	4,176	.....	.....
		† 82	3,936	.....	.....
5	J. T. Walker & Sons, Washington, D. C.	85	4,080	85	4,080
6	The National Building Supply Co., Baltimore, Md.	86	4,128	.....	.....
7	J. G. & J. M. Waters, Washington, D. C.	93	4,464	78	3,744

* Hoffman brand. † Crescent brand.

Abstract of proposals for sand, opened July 6, 1897, by Lieut. Col. Charles J. Allen, Corps of Engineers, United States Army.

No.	Name and address of bidder.	1,000 cubic yards.	
		Price.	Amount.
		Cents.	
1	Wm. A. Richards, Washington, D. C	43	430
2	John B. Lord, Washington, D. C	40	400

Abstract of proposals for pebbles, opened July 6, 1897, by Lieut. Col. Charles J. Allen, Corps of Engineers, United States Army.

No.	Name and address of bidder.	1,000 cubic yards.		Remarks.
		Price.	Amount.	
1	Wm. A. Richards, Washington, D. C	$0.70	$700.00	Bid not in triplicate. Alternative price of 48 cents named.
2	John B. Lord, Washington, D. C	.60	600.00	Bid not in triplicate.
3	Columbia National Sand Dredging Co., Washington, D. C	.59	590.00	
4	Francis H. Smith, New York, N. Y	2.00	2,000.00	

Abstract of proposals for riprap stone, opened July 6, 1897, by Lieut. Col. Charles J. Allen, Corps of Engineers, United States Army.

No.	Name and address of bidder.	1,300 cubic yards.	
		Price.	Amount.
5	Houston Construction Co., Philadelphia, Pa	$1.35	$1,755.00
6	J. H. Cranford, Washington, D. C	1.32	1,716.00
7	Chas. G. Smith & Son, Washington, D. C	1.17½	1,527.50
8	E. G. Gummel, Eckington, D. C	1.29	1,677.00

Abstract of proposals for broken stone, opened July 6, 1897, by Lieut. Col. Charles J. Allen, Corps of Engineers, United States Army.

No.	Name and address of bidder.	Coarse broken stone, 1,500 cubic yards.		Granolithic broken stone, 50 cubic yards.		Total.
		Price.	Amount.	Price.	Amount.	
5	Houston Construction Co., Philadelphia, Pa	$1.50	$2,250	$1.50	$75.00	$2,325.00
6	J. H. Cranford, Washington, D. C	1.68	2,520	1.98	99.00	2,619.00
7	Chas. G. Smith & Son, Washington, D. C	1.69½	2,542	2.00	100.00	2,642.50

Abstract of proposals for furnishing lifts and cranes, opened October 28, 1897, by Lieut. Col. Charles J. Allen, Corps of Engineers, United States Army.

No.	Name and address of bidder.	Double lift.	Single lift.	Two cranes.	Total.
1	H. A. Rogers, New York, N. Y	$647	$628	*a* $190	$1,465
2	New Jersey Foundry and Machine Works, New York, N. Y.	790	684	*b* 194	1,578
	New Jersey Foundry and Machine Works, New York, N. Y. (alternative bid)	756	742	125	1,623
3	Thomas Carlin's Sons, Allegheny, Pa	1,019	723	*c* 210	1,952

a $95 each. *b* $97 each. *c* $105 each.

Abstract of proposals for furnishing and installing electric light and power plant, opened April 24, 1898, by Lieut. Col. Charles J. Allen, Corps of Engineers, United States Army.

	General Electric Co.			Southern Electric Co.		
	Price per unit.	Amount.	Time.	Price per unit.	Amount.	Time.
			Days.			*Days.*
1 cistern		$750.00			$450.00	15
1 boiler		940.00			800.00	25
1 engine and dynamo		1,950.00			2,035.00	30
3 switch boards		1,250.00			800.00	30
1 blower		195.00			165.00	20
2 motors		1,050.00			1,210.00	
2 storage batteries		2,070.00			2,150.00	
450 feet, No. 0, B. & S. G. wire	$0.24	108.00		$0.13	58.50	
680 feet, No. 2, B. & S. G. wire	.17	115.60		.09⅝	65.28	
650 feet, No. 5, B. & S. G. wire	.10	65.00		.05	32.50	
530 feet, No. 8, B. & S. G. wire	.06	31.80		.03¼	17.22½	
1,400 feet, No. 16, B. & S. G. wire	.04	56.00		.01	14.00	
6 24-candlepower lamps	.30	1.80	35	.22	1.32	
66 16-candlepower lamps	.24	15.84		.22	14.52	
62 10-candlepower lamps	.24	14.88		.22	13.64	
3 desk stands	10.00	30.00		3.33	9.99	30
70 globes	6.00	420.00		4.00	280.00	
75 receptacles	5.00	375.00		1.33	99.75	
10 double-pole switches	12.00	120.00		4.63	46.30	
2 double-branch cut-outs, No. 5 wire	8.00	16.00		4.00	8.00	
35 single-branch cut-outs, No. 5 wire	8.00	280.00		4.33	151.55	
14 single-branch cut-outs, No. 16 wire	8.00	112.00		4.00	56.00	
2 single-branch cut-outs, No. 0 wire	10.00	20.00		5.33	10.66	
675 cleats	.04	27.00		.02½	16.87½	
1,665 feet conduit	.15	249.75		.07¼	120.71¼	
Install all fixtures in days						
Total		10,263.67			8,626.82¼	

	Tallmadge & Wilson.			John Finney.		
	Price per unit.	Amount.	Time.	Price per unit.	Amount.	Time.
			Days.			*Days.*
1 cistern		$387.10	18		$450.00	15
1 boiler		1,208.00	30		800.00	25
1 engine and dynamo		2,252.50	40		2,035.00	25
3 switch boards		1,126.00	20		800.00	30
1 blower		178.50	28		165.00	20
2 motors		720.50	28		1,210.00	30
2 storage batteries		1,963.50	40		2,150.00	30
450 feet, No. 0, B. & S. G. wire	$0.12	54.00		$0.13	58.50	
680 feet, No. 2, B. & S. G. wire	.08	54.40		.09⅝	66.30	
650 feet, No. 5, B. & S. G. wire	.04	26.00		.05	32.50	
530 feet, No. 8, B. & S. G. wire	.03	15.90		.03¼	17.22½	
1,400 feet, No. 16, B. & S. G. wire	.00⅝	11.20		.01	14.00	
6 24-candlepower lamps	.20	1.20		.22	1.32	
66 16-candlepower lamps	.20	13.20		.22	14.52	
62 10-candlepower lamps	.20	12.40		.22	13.64	
3 desk stands	4.00	12.00		3.33	9.99	
70 globes	2.45	171.50	30	4.00	280.00	30
75 receptacles	.70	52.50		1.33	99.75	
10 double-pole switches	6.00	60.00		4.63	46.30	
2 double-branch cut-outs, No. 5 wire	1.60	3.20		4.00	8.00	
35 single-branch cut-outs, No. 5 wire	.80	28.00		4.33	151.55	
14 single-branch cut-outs, No. 16 wire	.20	2.80		4.00	56.00	
2 single-branch cut-outs, No. 0 wire	2.00	4.00		5.33	10.66	
675 cleats	.01	6.75		.02½	16.87½	
1,665 feet conduit	.10	166.50		.07¼	120.71¼	
Install all fixtures in days						
Total		8,531.65			8,627.84¼	

Abstract of proposals for furnishing and installing electric light and power plant, opened April 24, 1898, etc.—Continued.

	Geo. F. Woolston. *a*		McCay Engineering Co. *b*		Electric Storage Battery Co.	
	Price per unit.	Amount.	Price per unit.	Amount.	Amount.	Time.
						Days.
1 cistern		$559.75		$837.00		
1 boiler		880.00		735.00		
1 engine and dynamo		1,768.00		2,143.00		
3 switch boards		465.00		740.00	$950.00	28
1 blower		102.00		173.00		
2 motors		807.50		1,273.00		
2 storage batteries		2,015.00		2,285.00	2,060.00	21
450 feet, No. 0, B. & S. G. wire	$0.09½	42.75	$0.28	126.00		
680 feet, No. 2, B. & S. G. wire	.07½	51.00	.19	129.20		
650 feet, No. 5, B. & S. G. wire	.04½	29.25	.11	71.50		
530 feet, No. 8, B. & S. G. wire	.03	15.90	.09	47.70		
1,400 feet, No. 16, B. & S. G. wire	.02	28.00	.05	70.00		
6 24-candlepower lamps	.30	1.80	.40	2.40		
66 16-candlepower lamps	.25	16.50	.35	23.10		
62 10-candlepower lamps	.25	15.50	.35	21.70		
3 desk stands	3.50	10.50	9.00	27.00		
70 globes	.70	49.00	1.60	112.00		
75 receptacles	4.50	337.50	.77	57.75		
10 double-pole switches	4.50	45.00	1.45	14.50		
2 double-branch cut-outs, No. 5 wire	6.50	13.00	1.60	3.20		
35 single-branch cut-outs, No. 5 wire	4.25	148.75	1.25	43.75		
14 single-branch cut-outs, No. 16 wire	4.25	59.50	1.20	16.80		
2 single-branch cut-outs, No. 0 wire	5.50	11.00	1.75	3.50		
675 cleats	.03	20.25	.08	54.00		
1,665 feet conduit	.11½	191.47½	.29	482.85		
Install all fixtures in days						
Total		7,683.92½		9,492.95		

a 50 days. *b* 23 days.

Abstract of proposals for furnishing and installing electric light and power plant, opened June 3, 1898, by Lieut. Col. Charles J. Allen, Corps of Engineers, United States Army.

	L. W. Woolston & Co., New York City. *a*		Royce & Marean, Washington, D. C. *c*		Electric Storage Battery Co., Philadelphia, Pa.		Fort Wayne Electric Corporation, Philadelphia, Pa. *d*
	Price per unit.	Amount. *b*	Price per unit.	Amount.	Amount.	Time.	
						Days.	
1 cistern		$490.00		$625.00			
1 boiler		800.00		748.00			
1 engine and dynamo		1,850.00		1,800.00			$1,985.00
3 switch boards		725.00		828.50	$950.00	35	
1 blower		145.00		350.00			
2 motors		950.00		1,000.00			
2 storage batteries		2,015.00		2,330.00	2,060.00	21	
450 feet No. 0 B. & S. G. wire	$0.11½	51.75	$0.22	99.00			
680 feet No. 2 B. & S. G. wire	.09	61.20	.16	108.80			
650 feet No. 5 B. & S. G. wire	.05	32.50	.12	78.00			
530 feet No. 8 B. & S. G. wire	.04	21.20	.10	53.00			
1,400 feet No. 16 B. & S. G. wire	.02	28.00	.04½	63.00			
6 24-candlepower lamps	.25	1.50	.20	1.20			
66 16-candlepower lamps	.23	15.18	.20	13.20			
62 10-candlepower lamps	.23	14.26	.20	12.40			
3 desk stands	4.50	13.50	7.50	22.50			
70 globes	2.75	192.50	2.25	157.50			
75 receptacles	4.50	337.50	4.10	307.50			
10 double-pole switches	4.50	45.00	4.50	45.00			
2 double-branch cut-outs, No. 5 wire	5.50	11.00	5.00	10.00			
35 single-branch cut-outs, No. 5 wire	5.25	183.75	5.00	175.00			
14 single-branch cut-outs, No. 16 wire	5.25	73.50	5.00	70.00			
2 single-branch cut-outs, No. 0 wire	6.00	12.00	5.00	10.00			
675 cleats	.03	20.25	.20	135.00			
1,665 feet conduit	.15	249.75	.15½	258.08			
Total		8,339.34		9,320.68			

a 30 days. *b* Lump bid of $7,983, in 30 days. *c* 24 days. *d* 35 days.

The following contracts were in force during the year:

John B. Lord, for 1,000 cubic yards of sand; date of contract July 23, 1897; approved July 28, 1897; delivery to be commenced August 1, 1897.

Columbia National Sand Dredging Company, for 1,000 cubic yards of pebbles; contract dated July 21; approved August 23, 1897; delivery to be commenced August 1, 1897.

The Houston Construction Company, for 1,550 cubic yards of broken stone; contract dated July 21; approved August 31, 1897; delivery to be commenced August 1, 1897.

Henry A. Jones & Co., for 4,000 barrels of cement; contract dated July 27; approved August 5, 1897; delivery to be commenced August 1, 1897.

Charles G. Smith & Son, for 1,300 cubic yards of riprap stone; contract dated July 27; approved August 7, 1897; delivery to be commenced August 1, 1897.

H. A. Rogers, for lifts, cranes, etc.; contract dated November 13; approved November 22, 1897; delivery to be completed January 12, 1898.

TORPEDOES FOR HARBOR DEFENSE.

An allotment for the torpedo defense of Washington, to meet deficiencies and to provide for further operations, was made June 11, 1898, from the appropriation for "Torpedoes for Harbor Defense, January 1, 1899," act of May 4, 1898.

For report of operations see report on national defense, under head of "Torpedo Defense."

Torpedo defense, explosives.—Under date of March 18, 1898, an allotment of $500 from the appropriation for "National Defense," act of March 9, 1898, was received for the purchase of explosives for submarine mines. This was increased by further allotment of $3,000 under date of April 4, from the same appropriation. Purchase of dynamite was begun in March and continued until in all nearly 5 tons had been purchased and stored, part being placed and planted in mines. A small temporary magazine was built in the woods on the reservation for temporary storage of such explosives as would require to be stored.

Money statement.

Amount of allotments	$3,500.00
June 30, 1898, amount expended during fiscal year	1,839.07
July 1, 1898, balance unexpended	1,660.93

Torpedo defense, submarine mines.—Under date of April 23, 1898, an allotment of $8,725 from the appropriation for "National Defense," act of March 9, 1898, was received for torpedo defense. This was increased by further allotment of $5,000, under date of June 11, from the appropriation for "Torpedoes for Harbor Defense, January 1, 1899," referred to above. Mines were planted. The casemate was fitted up and the operating machinery installed. Three triangulation stations were laid out, fitted with slight earth screens and connected by telephones, and one station connected with the casemate. The necessary small boats were purchased for planting, and patrol boats and patrols of the mined field were established and have been maintained. A small temporary engine house was built in a ravine near the casemate for installing the oil engine, rotary transformer, and storage battery; also an engine house in the old fort for the operating plant for the search light. These were all installed during the fiscal year.

This work was done by engineer soldiers and hired labor.

Money statements.

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

Amount of allotment	$8,725.00
June 30, 1898, amount expended during fiscal year	8,725.00

TORPEDOES FOR HARBOR DEFENSE, JANUARY 1, 1899.

Amount of allotments	$5,000.00
June 30, 1898, amount expended during fiscal year	386.55
July 1, 1898, balance unexpended	4,613.45
July 1, 1898, outstanding liabilities	1,158.00
July 1, 1898, balance available	3,455.45

Emplacements for three 8-inch guns on disappearing carriages.—This work has been carried on by contract under the provisions of the act of Congress of June 6, 1896. The contract was made with Douglas & Andrews, December 16, 1896. It was approved on the 31st of the same month. Work under the contract was to be commenced December 23, 1896, and completed September 1, 1897. Work commenced upon the wharf in January and upon the excavation in March, 1897. By the close of the fiscal year ended June 30, 1897, the wharf had been practically completed, and most of the excavation for the concrete work had been done, and part of the drainage system had been put in. The laying of concrete in the floors and footings of the magazines and passageways had begun, a well had been sunk, and the contractors had assembled and set up plant and temporary buildings.

WORK OF THE PAST FISCAL YEAR.

The wharf was completed in July, 1897. It is built of piles and lumber, and extends from the shore to a depth of 18 feet at low tide—a length of 2,000 feet. The construction of a system of fender piles for protecting the wharf from floating ice was begun November 23, 1897, and was finally completed in February, 1898.

The excavation for emplacements was completed in July, 1897. The concrete construction was begun in June, 1897, and was continued to December 2, 1897, when it was suspended on account of the approach of freezing weather. No work was done from December 2 to March 1, 1898, except upon the construction of fenders at the wharf. Early in March work was resumed at the construction of gun platforms, and these were made ready for mounting the guns on March 15. Work was then resumed on the construction of the parapet and traverses, and at the excavation of a ridge in the field of fire which obstructed the view of the river.

The excavation of the roadway in rear of the battery was begun in May and completed in June, 1898. The construction of the concrete work, the excavation, placing of lifts, ladders, railings, trolley rails, sewer system, and a part of the soil covering for embankment and gravel on the roadway were completed. The value of work done during the year is $74,960.86.

The force employed at the work varied from about 45 men in July, 1897, to about 100 men and 6 to 8 teams in April and May, 1898. No machinery whatever has been employed in the construction, except the locomotive for hauling material and the pump which supplied water. The mixing and conveying of concrete was done entirely by hand.

Much serious delay occurred throughout the work on account of lack

of material, especially of cement. The completion of the work was also retarded by delay in excavating the roadway in the rear of the emplacements and in completing the sewer system so as to drain the interior of the emplacements and thus facilitate the completion of the work inside.

The date originally fixed for completion of the contract was September 1, 1897. Extensions have been granted as follows: To December 30, 1897; to May 31, 1898, and to June 30, 1898.

The work remaining to be done under Douglas & Andrews's contract at the close of the fiscal year was as follows: Completion of embankment and placing soil on the same, the soil covering being about two-thirds completed; building about 300 linear feet of gutters; completing cranes and iron stairway, and supplying part of the hoists for trolleys and cranes; completing gravel on roadway; completing whitewashing; clearing away material, plant, etc.

Money statement.

July 1, 1897, balance unexpended	$86,346.65
June 30, 1898, amount expended during fiscal year	64,838.06
July 1, 1898, balance unexpended	21,508.59
July 1, 1898, amount covered by uncompleted contracts	11,717.00
July 1, 1898, balance available	9,791.59

Contingent expenses: Under this head the inspection and supervision of work under the contract and the necessary engineer operations connected therewith have been in progress.

The dwelling house used for engineer quarters was removed from the field of fire and repaired.

Money statement.

July 1, 1897, balance unexpended	$3,562.88
Received by transfer	742.83
	4,305.71
June 30, 1898, amount expended during fiscal year	5,974.80
July 1, 1898, deficiency	*1,669.09

Mounting guns and carriages.—As soon as the gun platforms were ready the base rings and traverse rails of the gun carriages were set, under an agreement with Douglas & Andrews, they receiving $100 per set for doing the work, including transportation from the wharf. This work was done March 11 to March 19, 1898.

The removal of carriages and guns from the shore to the gun platforms was begun on March 13 and the mounting of the three guns and carriages was completed on April 1, having been accomplished in twenty days, including moving them distances of 1,100 to 1,300 feet up hill. This work was done under agreement with Littlefield, Alvord & Co., who employed for the purpose a steam hoisting engine and 15 men, with two 2-horse teams.

Money statement.

Amount of allotment	$1,850.00
June 30, 1898, amount expended during fiscal year	1,821.72
July 1, 1898, balance unexpended (deposited in Treasury)	28.28

*Covered by transfer made subsequent to close of fiscal year.

Preservation and repair.—A wire fence 5 feet high was built on the reservation boundary line as far as funds would permit. About 5,850 linear feet were completed, at a cost of $340. This work is still incomplete. Stone monuments were cut and set at the corners of the reservation, after carefully recovering the lines. Work was suspended on the fence when the allotment was exhausted. The work was begun in October, 1897, and was suspended in December following.

Money statement.

July 1, 1897, balance unexpended	$396.67
June 30, 1898, amount expended during fiscal year	396.67

Telephone booths.—Three telephone booths were constructed at the gun platforms. This work was completed in June, 1898.

Money statement.

Amount of allotment	$120.00
June 30, 1898, amount expended during fiscal year	113.75
July 1, 1898, balance unexpended	6.25
July 1, 1898, outstanding liabilities	6.25

Abstract of proposals for furnishing steel I-beams, opened April 9, 1898, by Lieut. Col. Charles J. Allen, Corps of Engineers, United States Army.

Name and address of bidder.	Price per pound (1,423 pounds).	Amount.	Date of delivery.
	Cents.		*Days.*
James H. McGill, Washington, D. C	2¼	$32.02	2
C. A. Schneider's Sons, 212 Twelfth street NW., Washington, D. C	2¼	32.02	7

The following contracts were in force during the year:

Douglas & Andrews, for construction of wharf and emplacements for three 8-inch guns, date of contract December 16, 1896; approved December 31, 1896; date of commencement, December 22, 1896; the date of completion was originally September 1, 1897. The following extensions have been granted: To December 30, 1897; to May 31, 1898; to June 20, 1898, and to June 30, 1898.

James H. McGill, for furnishing I-beams, contract dated April 11, 1898; approved April 20, 1898; date of delivery April 14, 1898; amount of contract, $35.

The trees on one of the reservations and on adjoining farms were felled so as to give an unobstructed view of the river, and were partly cut into firewood.

An observing tower 40 feet high and a shelter station were erected at the ends of a range-finding base.

The funds for this work were provided from the appropriation for "National Defense," act of March 9, 1898.

Money statement.

Amount of allotments	$925.00
June 30, 1898, amount expended during fiscal year	837.24
July 1, 1898, balance unexpended	87.76
July 1, 1898, outstanding liabilities	52.00
July 1, 1898, balance available	35.76

4 I.

DEFENSES OF HAMPTON ROADS, VIRGINIA.

Officer in charge, Maj. Thomas L. Casey, Corps of Engineers; assistants, Lieut. Frank A. Wilcox, First Infantry, from April 20, 1898, and Lieut. Edward H. Schulz, Corps of Engineers, from April 9 to May 19, 1898. Division Engineer, Brig. Gen. Peter C. Hains, U. S. Volunteers, Colonel, Corps of Engineers.

Redoubt A, a battery of two 10-inch guns exterior to the main work, has been completed; also a single-gun battery of the same caliber, a mortar battery, platform for 8-inch rifle on barbette carriage, and the two mining casemates. Work is under way for two 10-inch gun redoubts, to be known as B and C, and construction will begin early in the fiscal year 1899 on emplacements for three 12-inch guns and one of 10 inch. In addition, four temporary platforms for 8-inch rifles on barbette carriages have been completed and three of the pieces mounted. Of the rapid-fire armament three platforms for 4.72-inch guns have been constructed and the mountings and guns placed.

A range-finder tower has been erected in connection with the operation of these batteries and a concrete tank constructed for the wet storage of submarine cable.

The work performed during the fiscal year ended June 30, 1898, is exhibited as follows:

Emplacements and platforms for two 10-inch guns (Redoubt A).—These emplacements and platforms had been completed at the close of the fiscal year 1897, and the guns and carriages mounted.

During the fiscal year, on account of seepage of water into the magazines, cement plaster with a coating of bitumen and tar was placed on the top surface of the concrete directly over the magazines. This proving ineffective, two coats of refined Trinidad asphalt were added.

As a rear view of the emplacements in Redoubt A could be readily obtained, the planting of a hedge to screen them was authorized and $200 provided for this purpose. The hedge, which consists of a double row of California privet and red cedars, was planted in March, 1898, and is 450 feet long. The expense was paid from funds for the mortar battery.

For lighting the magazines of this battery a portable storage battery of the chloride type, with mean voltage of 56 and normal discharge of 20 amperes for ten hours, has been installed. The wiring was placed in iron-armored conduits and provision made for ten 16-candlepower lights for each emplacement. The battery was placed in a small brick house built for the purpose behind the parapet near the south traverse. This work was included in the contract for the electric plant at the mortar battery and cost $1,105.

Money statements.

EMPLACEMENTS.

July 1, 1897, balance unexpended	$1,614.17
June 30, 1898, amount allotted during fiscal year	1,605.00
	3,219.17
June 30, 1898, amount expended during fiscal year	2,114.17
July 1, 1898, balance unexpended	1,105.00
July 1, 1898, outstanding liabilities	1,105.00

PLATFORMS.

July 1, 1897, balance unexpended	198.41
June 30, 1898, amount expended during fiscal year	198.41

Allotments.

EMPLACEMENTS.

Act February 24, 1891, allotment of June 11, 1891	$158,848.00
Act July 23, 1892, allotment of July 26, 1895	3,774.00
Act March 3, 1897, allotment of May 20, 1897	1,300.00
Act June 6, 1896, allotment of January 8, 1898	1,105.00
Act June 6, 1896, allotment of April 7, 1898	500.00
Authorized expenditure of funds allotted for other works	200.00
Total for emplacements	165,727.00

PLATFORMS.

Act March 2, 1895, allotment of July 26, 1895	$10,292.00

Emplacement and platform for one 10-inch gun.—Work has been confined during the fiscal year to preventing the seepage of water into the magazine by applying cement plaster, with covering of bitumen and tar, on the top surface of the concrete, and finally by applying two heavy coats of Trinidad asphalt. The cost of this work was paid from funds provided in allotments for emplacements for two 10-inch guns.

A small chloride electric storage battery, capable of running ten 16-candlepower incandescent lights, was installed in a small brick shelter constructed especially for this battery. The necessary wiring for the lights was placed in iron-armored conduits.

Money statements.

EMPLACEMENT.

July 1, 1897, balance unexpended	$13.48
June 30, 1898, allotted during fiscal year	552.50
	565.98
June 30, 1898, expended during fiscal year	13.48
July 1, 1898, balance unexpended	552.50
July 1, 1898, outstanding liabilities	552.50

PLATFORM.

July 1, 1897, balance unexpended	193.25
June 30, 1898, amount expended during fiscal year	193.25

Allotments.

EMPLACEMENT.

Act July 23, 1892, allotment of November 8, 1892	$64,000.00
Act June 6, 1896, allotment of January 8, 1898	552.50
Total	64,552.50
Amount transferred to other works	9,774.00
Amount available for expenditure	54,778.50

PLATFORM.

Act March 2, 1895, allotment of July 26, 1895	$5,020.00

Emplacement for 10-inch gun on spit.—The plans for this emplacement, which is at the left flank of Redoubt B, were approved October 13, 1897, and $50,000 allotted for the work from the appropriation for gun and mortar batteries in the act of March 3, 1897.

As far as the special conditions of the site would permit, the plans of The Board of Engineers of 1896 were followed, but as the rear of the battery is exposed to oblique fire it was necessary to run a traverse back farther to inclose the magazines and to prolong this traverse with sand inclosed by concrete revetment walls. The carriage which is to be mounted in this emplacement is an experimental one, patterned after the model 1894 disappearing type, and necessitated the construc-

tion of the platform proper with slight changes in details of the plans for that model, the loading platform and rooms underneath conforming as nearly as possible to the 1896 plans.

The material for the emplacement and platform was purchased after newspaper advertisement dated November 23, 1897. An abstract of the bids received in response is appended.

Excavation for the foundation commenced November 24, 1897, but before concrete could be actually placed it was necessary to remove a large amount of sand in the rear. This was done as fast as possible and the sand used in covering for mortar battery and the mining casemate near Reboubt A, and also as cover for the work itself.

The plant used for concrete work consisted of the 4-foot cube mixer and appurtenances used for the mortar battery, a track with switch being laid to the site of the work. The continuous Cockburn mixer, which was placed to the south of the emplacement, was also effective. For the former, horse cars with trays delivered the concrete to a derrick in the rear of the work. The latter was served by wheelbarrows.

Before any concrete had been placed about 12,038 cubic yards of the sand cover had been provided. In addition to this, during the fiscal year 2,622.7 cubic yards of concrete have been placed in the platform and main work, 73.5 and 88.73 cubic yards of soil and clay, respectively, and 253 square yards of sod placed on slope.

On June 30, 1898, the following work remained to be done to complete the emplacement and platform: Completing shell recess from reference 15′, providing ammunition lift, trolley system and electric storage battery for lighting, and completing slopes.

Money statement.

June 30, 1898, amount allotted during fiscal year	$50,000.00
June 30, 1898, amount expended during fiscal year	29,671.30
July 1, 1898, balance unexpended	20,328.70
July 1, 1898, outstanding liabilities	3,918.28
July 1, 1898, balance available	16,410.42

Allotment.

Act March 3, 1897, allotment of October 13, 1897	$50,000.00

Abstract of proposals for furnishing and delivering cement, broken stone, and yellow-pine lumber, received in response to advertisement dated November 23, 1897, opened by Capt. Thomas L. Casey, Corps of Engineers, United States Army, at Norfolk, Va., January 11, 1898.

CEMENT.

No.	Name and address of bidder.	American. Approximate quantity, 8,000 barrels.			Portland. Approximate quantity, 250 barrels.		
		Brand.	Price bid per barrel.	Total.	Brand.	Price bid per barrel.	Total.
1	Lawrence Cement Co., New York, N.Y.	Hoffman	a$0.82 b .72	$6,560 5,760			
2	Atlas Cement Co., New York, N. Y.				Atlas	$2.21	$552.50
4	New York and Rosendale Cement Co., New York, N. Y.	Brooklyn Bridge	.899	7,192			
6	Lawrenceville Cement Co., New York, N. Y.	Beach's Rosendale.	.95	7,600			
8	R. H. Hood, New York, N. Y	Round Top	.74	5,920	Atlas	2.10	525.00
10	Sinclair & Babson, New York, N. Y				Alsen	2.35	587.50
14	Warner Moore & Co., Richmond, Va	James River	.90	7,200	Alpha	2.15	537.50

a For cement ordered before opening of navigation of Hudson River.
b For cement ordered after opening of navigation of Hudson River.

Abstract of proposals for furnishing and delivering cement, etc.—Continued.

BROKEN STONE.

No.	Name and address of bidder.	2-inch. Approximate quantity, 4,000 cubic yards.		1-inch. Approximate quantity, 2,665 cubic yards.		Granolithic. Approximate quantity, 35 cubic yards.	
		Price bid per cubic yard.	Total.	Price bid per cubic yard.	Total.	Price bid per cubic yard.	Total.
3	McClenahan & Bro. Granite Co., Port Deposit, Md.	$1.79	$7,160.00	$1.79	$4,770.35	$1.79	$62.65
5	Chas. G. Smith & Son, Washington, D. C.	1.77	7,080.00	1.88	5,010.00	2.40	84.00
8	R. H. Hood, New York, N. Y.	1.50	6,000.00	1.70	4,530.00	2.00	70.00
12	John L. Grim, Philadelphia, Pa.	1.88	7,520.00	1.88	5,010.00	3.25	113.75
13	Peter Donald & Son, Richmond, Va.	1.83	7,320.00	1.83	4,876.95	1.83	64.05
14	Warner Moore & Co., Richmond, Va.	1.88	7,520.00	1.88	5,010.00	2.00	70.00

YELLOW-PINE LUMBER.

No.	Name and address of bidder.	1 inch by 12 inches by 16 feet. Approximate quantity, 3,008 feet B. M.		2 inches by 4 inches by 16 feet. Approximate quantity, 533 feet B. M.		2 inches by 12 inches by 16 feet. Approximate quantity, 14,016 feet B. M.	
		Price bid per 1,000 feet B. M.	Total.	Price bid per 1,000 feet B. M.	Total.	Price bid per 1,000 feet B. M.	Total.
7	Jac. Heffelfinger, Hampton, Va.	$11.00	$33.09	$11.00	$5.86	$12.00	$168.19
8	R. H. Hood, New York, N. Y.	15.00	45.12	15.00	8.00	15.00	210.00
9	C. H. Bull & Co., Norfolk, Va.	16.00	48.13	12.00	6.40	12.00	168.19
11	The Manhattan Supply Co., New York, N. Y.	24.70	74.30	24.70	13.16	24.70	346.20

No.	Name and address of bidder.	2 inches by 12 inches by 16 feet, one side and both edges dressed. Approximate quantity, 16,000 feet B. M.		2 inches by 6 inches by 16 feet. Approximate quantity, 2,000 feet B. M.		3 inches by 4 inches by 16 feet. Approximate quantity, 2,000 feet B. M.	
		Price bid per 1,000 feet B. M.	Total.	Price bid per 1,000 feet B. M.	Total.	Price bid per 1,000 feet B. M.	Total.
7	Jac. Heffelfinger, Hampton, Va.	$15.00	$240.00	$11.00	$22.00	$11.00	$22.00
8	R. H. Hood, New York, N. Y.	15.00	240.00	15.00	30.00	15.00	30.00
9	C. H. Bull & Co., Norfolk, Va.	14.50	232.00	12.00	24.00	12.00	24.00
11	The Manhattan Supply Co., New York, N. Y.	25.70	395.20	24.70	49.40	24.70	49.40

No.	Name and address of bidder.	3 inches by 4 inches by 26 feet. Approximate quantity, 3,250 feet B. M.		3 inches by 4 inches by 20 feet. Approximate quantity, 2,500 feet B. M.		1½ inches by 3 inches by 16 feet, tongued and grooved. Approximate quantity, 2,000 feet B. M.		Aggregate amount of bid.
		Price bid per 1,000 feet B. M.	Total.	Price bid per 1,000 feet B. M.	Total.	Price bid per 1,000 feet B. M.	Total.	
7	Jac. Heffelfinger, Hampton, Va.	$18.00	$58.50	$11.00	$27.50	$20.00	$40.00	$617.14
8	R. H. Hood, New York, N. Y.	15.00	48.75	15.00	37.50	15.00	30.00	679.61
9	C. H. Bull & Co., Norfolk, Va.	12.00	39.00	12.00	30.00	18.00	36.00	607.62
11	The Manhattan Supply Co., New York, N. Y.	24.70	80.28	24.70	61.75	30.00	60.00	1,129.69

Abstract of contracts in force.

Name of contractor.	Date of approval.	Date of beginning delivery of materials.	Date of expiration.
R. H. Hood	Feb. 15, 1898	Feb. 15, 1898	June 30, 1898

Emplacement for 10-inch gun in main work.—Plans and estimate for the construction of the last 10-inch emplacement proposed were submitted to the Chief of Engineers, June 15, 1898. The plans had not been approved June 30, 1898.

Battery for three 12-inch guns.—Plans for this battery, with an estimate of its cost, were submitted June 25, 1898. They are to be designed for the disappearing carriage, model 1897, and the plans followed those adopted for that mount by The Board of Engineers in every detail. According to the approved project of defense two 12-inch gun batteries were to be placed within the fort, but the idea of placing them on the beach, between Redoubts B and C, was presented to the Department for consideration. No action had been taken as to plans and location of the guns at the close of the fiscal year.

Mortar battery.—This battery, consisting of sixteen 12-inch mortars, twelve on model 1896 carriages and four on model 1891, with the four pits in a single line, has been practically completed, carriages assembled, and mortars mounted.

No unusual difficulties were encountered in the construction of the battery, and the work was carried on by methods generally used.

The main concrete work was completed before the close of the fiscal year 1897, with the exception of the sloping revetting walls above the pits.

During the fiscal year 1898, 1,006 cubic yards of Rosendale concrete was used in building the retaining walls above the pits and at the foot of the traverses, 6,034 square feet of granolithic finish put on floors of pits, 74,846 cubic yards of sand placed in slopes, and this covered with 2,019 cubic yards of soil, 2,271 cubic yards of clay, and 2,818 square yards of sod. Double trolley systems have been installed in each of the four shell rooms, spiral stairs erected in observation tower, sheet steel doors hung at entrances to pits, and an electric plant consisting of 5-kilowatt dynamo, 7-horsepower oil engine, belt connected to dynamo, and a nonportable storage battery of a mean voltage of 56, with 30 amperes normal discharge for ten hours, set up. For the electric plant a small room was partitioned off by a 9-inch brick wall in the passageway near the entrance from pit No. 3. The oil tank was set in the traverse on the north side of the pit.

Provision was made for twenty 16-candlepower lamps, and all wiring was placed in iron-armored conduits. The cost of the plant under contract, with the portable storage batteries for Redoubt A and the emplacement in salient, was $4,420, $2,762.50 to be for this work, $1,105 for Redoubt A, and $552.50 for the emplacement in salient. An arrangement for firing the mortars has been designed and installed, and firing and relocating rooms built back of the traverses.

On October 1, 1897, four full service charges were fired from the inner right mortar in pit No. 3 to test the platform, which was built wholly of Portland cement concrete. The concrete at that time had been in place about ten months. Two rounds were fired with the piece at an elevation of 60 degrees and two at 45 degrees. No crack, chipping, or other defect was discernible, either in the wall or upper surface of the

platform. The sloping breast-height wall was practically uninjured by the blast, only a few flakes of the cement finish on the wall being removed.

The total amount of concrete placed in constructing the battery was 21,741 cubic yards, divided as follows:

	Cubic yards.
In main work	16,712
In platforms in pits Nos. 3 and 4 and part of No. 2	1,685
In wing walls	1,585
In retaining walls around pits	918
In retaining wall at foot of traverses	138
In passageways between pits	703

The cost of the different parts of the work and the total cost of battery may be stated as follows:

BUILDING SLOPES.

78,546 cubic yards of sand, at 44 cents	$34,560.24
5,132 cubic yards of clay and soil, at $1.46	7,492.72
2,818 square feet of sod, at 28 cents	789.04
Total cost of slopes	42,842.00

MAIN WORK.

16,712 cubic yards of concrete, at $4.10	$68,519.20
Total cost of main work	68,519.20

PLATFORMS.

1,685 cubic yards of concrete, at $6.568+	$11,067.08
534 steel bolts in place, at $4.695+	2,507.51
6,034 square yards granolithic finish, at $0.1147+	689.37
64 pieces stone, 18 inches by 3 feet, by 6 feet 3 inches, dressed and set, at $59.245+	3,791.74
4 force pumps set and connected in recesses of wing walls, at $10.505	42.02
16 drain wells filled with broken stone, at $3.305	52.90
Increasing diameter of wells 9 inches	168.50
Total cost of platforms	18,319.12

WING WALLS.

1,585 cubic yards of concrete, at $4.42+	$6,997.09
Total cost of wing walls	6,997.09

RETAINING WALL AROUND PITS.

918 cubic yards concrete, at $5.595+	$5,134.23
Total cost of retaining walls	5,134.23

WALLS AT FOOT OF TRAVERSES.

138 cubic yards concrete, at $6.53	$901.14
Total cost of traverse foot walls	901.14

PASSAGEWAYS BETWEEN PITS.

703 cubic yards of concrete, at $4.33	$3,043.99
Total cost of passageways	3,043.99

MISCELLANEOUS ITEMS.

4 inside doors for magazines, at $25.25¾	$101.03
Firing apparatus and tanks for electric plant	1,193.82
Relocator houses	499.55
Double trolley systems in magazines	1,479.48
Spiral stairs in tower	296.00
Brick ventilator	20.63
Cutting niche in wall to traverse mortar	28.30
4 sheet-steel doors, at $46.50	186.00
Services of watchmen	1,213.50
Cost of plant (about 56 cents for each cubic yard of all concrete)	12,073.70
Repairs to plant (about 31 cents for each cubic yard of all concrete)	6,729.34
Electric plant	2,762.50
Hauling mortars, carriages, and miscellaneous material	1,010.46
Total cost of miscellaneous items	27,594.31

The above items do not include superintendence, and indicate the total cost of the battery to have been $173,350.98.

Of the amount provided for this battery, $4,657.50 was transferred to other works, and $6,767.25 was expended for labor in connection with construction of railroad to connect with Chesapeake and Ohio tracks.

Money statement.

July 1, 1897, balance unexpended		$67,338.12
June 30, 1898, amount transferred to other works during fiscal year	$4,657.50	
June 30, 1898, amount expended during fiscal year	52,907.30	
		57,564.80
July 1, 1898, balance unexpended		9,773.32
July 1, 1898, outstanding liabilities		6,035.00
July 1, 1898, balance available		3,738.32

ALLOTMENTS.

Act February 24, 1891, allotment of March 18, 1896	$5,118.50
Act March 2, 1895, allotment of March 11, 1895	94,881.50
Act June 6, 1896, allotment of July 1, 1896	100,000.00
Total	200,000.00
Amount transferred to other works	4,657.50
Amount available for battery	195,342.50

Abstract of bids for furnishing and setting up an electric-lighting plant received in response to advertisement dated November 15, 1897, and opened by Capt. Thomas L. Casey, Corps of Engineers, United States Army, at Norfolk, Va., at 12 o'clock noon December 23, 1897.

No.	Name and address of bidder.	Amount bid.			
		Class A.—Dynamo engine and switch board complete.	Class B.—1 nonportable and 2 portable storage batteries in trays.	Class C.—Wiring, lamps, cut-outs, switches, etc.	For complete plant.
1	Electric Storage Battery Co., Philadelphia, Pa.	.....	$2,530.00	.....	.....
2	Driggs and Woodward, Brooklyn, N. Y.	$1,981.80	2,949.90	$2,428.25	.....
3	Sprague Electric Co., New York, N. Y.	1,545.00	2,530.00	1,267.00	$5,342.00
4	Western Electric Co., New York, N. Y.	.....	2,530.00	.....	.....
5	General Electric Co., Baltimore, Md.	1,882.85	.....	.....	.....
6	Jas. L. Belote, Norfolk, Va.	1,598.00	2,980.00	1,160.00	.....
7	McCay-Howard Engineering Co., Baltimore, Md.	1,394.00	2,390.00	790.00	4,420.00

Abstract of contract in force.

Name of contractor.	Date of approval.	Date of beginning work.	Date of expiration.
McCay-Howard Engineering Co.	Mar. 18, 1898	Feb. 12, 1898	May 12, 1898

Platform for 8-inch rifle on A. R. F. barbette carriage, model 1892.—Funds were provided for this work by transfer from the allotments for the mortar battery.

The rifle was mounted for some time on a platform at the northern end of the water battery for use in target practice, and as this position would be disadvantageous in case of an emergency it was considered advisable to make it a part of the permanent defense by placing it on a platform behind the cover of the mining casemate.

Work was commenced on the platform March 15, 1898, and the gun and carriage had been transferred and mounted early in June, 1898. A small magazine was constructed near the covered way to serve the piece. The platform and magazine cost $1,608.08, 210.37 cubic yards of concrete being used for the work.

Money statement.

June 30, 1898, amount allotted during fiscal year	$1,800.00
June 30, 1898, amount expended during fiscal year	1,544.70
July 1, 1898, balance unexpended	255.30
July 1, 1898, outstanding liabilities	63.38
July 1, 1898, balance available	191.92

Observation stations.—At the request of the commanding officer, the construction of two observation stations was authorized. Sites for them were selected, and both have been completed and the instruments installed.

Money statement.

June 30, 1898, amount allotted during fiscal year	$500.00
June 30, 1898, amount expended during fiscal year	499.39
July 1, 1898, balance unexpended	.61

Mining casemate.—The construction of this, the second, mining casemate at this place was begun in June, 1897. The casemate and gallery had been completed at the close of the fiscal year.

To construct the casemate and passage 707 cubic yards of concrete was consumed and for the gallery, 72 feet long, 251 cubic yards additional. 12,502 cubic yards of sand was hauled from the dunes below the old cemetery and placed in the protecting slope in front of the casemate and over the operating room and passage and the slopes were covered with 245 cubic yards of clay, 244 cubic yards of soil, and 1,559 square feet of sod. A retaining wall was built at the foot of the interior slopes with 127.4 cubic yards of concrete, and 17 cubic yards used for roadway of the double caponiere. A footing slope of old concrete was built along the exterior slope of the face cover.

The excavation for the cable gallery was made to reference —2, where the material was found to be very soft throughout its entire length. A secure foundation was made with old concrete and stone and sheet piling driven so that the trench could be kept dry for laying the concrete for the gallery.

A balance of about $5,000 will be left from the $21,000 provided for the work when all expenses are paid.

An allotment of $150 was made during the fiscal year for providing storage facilities for delicate instruments issued for use in connection with the submarine-mine defense, $20 of which has been expended for that purpose.

Money statement.

July 1, 1897, balance unexpended	$20,978.03
June 30, 1898, amount allotted during fiscal year	150.00
	21,128.03
June 30, 1898, amount expended during fiscal year	14,603.93
July 1, 1898, balance unexpended	6,524.10
July 1, 1898, outstanding liabilities	990.40
July 1, 1898, balance available	5,533.70

Allotments.

Act March 3, 1897, allotment of June 3, 1897	$21,000.00
Act March 3, 1897, allotment of August 10, 1897	150.00
Total	21,150.00

Cable storage tank.—A storage tank of concrete with a capacity for 30 drums of cable was constructed under contract, at a cost of $2,072.79. The contract price for the tank, with overhead traveler, was $1,560, and the balance of the cost was for inspection and connecting tank with water supply.

Money statement.

July 1, 1897, balance unexpended		$1,907.21
June 30, 1898, amount expended during fiscal year	$1,880.00	
June 30, 1898, repaid to appropriation	27.21	
		1,907.21

Allotment.

Act June 6, 1896, allotment of April 6, 1897	$2,100.00

Abstract of contract in force.

Name of contractor.	Date of approval.	Date of beginning work.	Date of expiration.
John H. Brinson	May 26, 1897	May 20, 1897	Nov. 20, 1897

Breakwater and beach protection.—It was noticed in September, 1897, that the breakwater was somewhat disintegrated along its lower parts, due, probably, to the solvent action of the sea water and impact of pebbles. In some parts it has been eroded to a depth of 6 inches. The condition has not changed materially, and at present the stability of the breakwater is not endangered. The jetties on the beach remain in good condition.

Artesian well.—No work has been done and no expenditures made on account of this work during the fiscal year ended June 30, 1898.

Money statement.

July 1, 1897, balance unexpended	$5,908.95
July 1, 1898, balance unexpended	5,908.95

Appropriation.

Act February 24, 1891	$6,000.00

Preservation and repair of fortifications.—The bridges over moat have been repaired and a new board walk laid from the main street to the south end of the water battery. The engineer quarters have been repaired and office and storehouses painted. All the quarters have been connected with the Newport News water system, at a cost of $150.

A survey and map of the entire reservation was made and placed on file. A discrepancy in the marking of the northern boundary was discovered, giving the United States 80,000 square feet more land.

Money statement.

July 1, 1897, balance unexpended	$150.00
June 30, 1898, amount allotted during fiscal year	3,500.00
	3,650.00
June 30, 1898, amount expended during fiscal year	3,648.12
July 1, 1898, balance unexpended	1.88

Allotments.

Act March 3, 1897, allotment of May 13, 1897	$150.00
Act March 3, 1897, allotment of June 14, 1897	3,000.00
Act March 3, 1897, allotment of November 1, 1897	500.00
Total	3,650.00

Fort Wool, Va.—This is an inclosed casemated fort. It was begun in 1818 by forming an artificial foundation of stones of random sizes unloaded upon a 10-foot shoal, selected as the site of the work. When the scarp walls and piers had reached a height to include the lintels of the lower tier of embrasures settlement began and work was stopped after piling a quantity of stone upon the walls sufficient to bring upon the foundation a pressure somewhat exceeding that of the finished work.

The work of construction was resumed in 1858, and when it was suspended 52 casemates of the lower tier, with iron-throated embrasures, were finished and ready for guns. On the second tier the scarp walls and piers of those portions of the work bearing on the channel had reached nearly to the height of the embrasure lintels, the embrasure irons had been set, and the floors of most of the casemates paved. On the gorge faces very little work had been done.

There is a quantity of public property, such as building material, etc., stored in the fort. A fort keeper is in charge of the public property.

The fort has remained in charge of a custodian during the year.

Money statement.

July 1, 1897, balance unexpended	$695.11
June 30, 1898, amount expended during fiscal year	600.00
July 1, 1898, balance unexpended	95.11
July 1, 1898, outstanding liabilities	50.00
July 1, 1898, balance available	45.11

Allotment.

Act March 3, 1897, allotment of June 14, 1897	$425.00

The following operations were carried on under allotments from the appropriation for "National Defense," act of March 9, 1898:

Three 10-inch gun emplacements.—A provisional allotment was made for these emplacements on March 18, 1898, of $75,000, and on June 11, 1898, $50,000 additional was allotted.

The emplacements are being constructed in one 2-gun redoubt known as C, and situated on the beach front northeast of Redoubt A. The other emplacement is to form the right half of Redoubt B. With the exception of the latter, which was necessarily modified to correspond with the left half of the redoubt, the plans follow the latest designs of The Board of Engineers.

Work of construction was commenced on the right half of Redoubt B on March 21, 1898, and on Redoubt C March 29, 1898. For the latter a 5-foot cube mixer was purchased and set up. It was also necessary to purchase a new locomotive and about one-half mile of steel rails, with necessary ties. Two derricks were placed, a loop of track laid around the site of the battery, and a cement house of 4,000 barrels capacity erected.

REDOUBT C.

On June 1, 1898, the platforms proper of Redoubt C were ready for the base ring, and by June 30, 1898, the concrete of the battery was in position to reference 22.

Before any concrete could be placed a filling of 5 feet for the foundation of the battery had to be made. In the absence of the railroad material necessary to extend the track a sufficient distance to permit the sand to be brought in cars, resort was had to horse and cart for moving the sand for the fill. There were no dunes in the vicinity of the work and the sand was taken from the beach, and the haul was a heavy one through the sand, so that the carts could not be loaded full. This method, together with the nonreceipt of bolts and construction material, retarded the work to some extent.

During the fiscal year the following work has been done: 3,725 cubic yards of concrete have been placed, a retaining wall of old concrete built at the foot of the exterior slope, and 2,186 cubic yards of sand hauled from dunes near old cemetery and deposited in the slope.

RIGHT HALF OF REDOUBT B.

The main work of this emplacement had been brought up to reference 18 at the close of the fiscal year by placing 1,067 cubic yards of concrete. The sand excavated for the foundation amounted to 10,390 cubic yards, and has been placed in the slope.

The material for concrete for both redoubts has been purchased under oral agreement, but the prices for which it is obtained are the same as that purchased under contract for the left half of Redoubt B.

Money statement.

June 30, 1898, amount allotted during fiscal year	$125,000.00
June 30, 1898, amount expended during fiscal year	26,977.20
July 1, 1898, balance unexpended	98,022.80
July 1, 1898, outstanding liabilities	20,340.48
July 1, 1898, balance available	77,682.32

Allotments.

Act March 9, 1898, allotment of March 18, 1898	$75,000.00
Act March 9, 1898, allotment of June 11, 1898	50,000.00
Total	125,000.00

Four 4.72-inch rapid-fire gun emplacements.—The construction of two emplacements and platforms for these guns was ordered April 6, 1898, and the other two on April 13, 1898, an aggregate of $18,000 being allotted for the work.

According to the project for rapid-fire armament, these guns were intended for bastions 1 and 2 of the main work, but for obvious reasons authority was granted to mount them on platforms on the barbette tier of front 4 and the work was commenced on two of the platforms on April 13, 1898, and they were completed April 30, 1898. One other was started and completed in June, 1898. Construction of the other platform has been deferred until the gun and mount arrive.

Five old platforms occupied the sites selected for the three guns, and they were removed and 81 cubic yards of excavation made for the platforms and magazine. The amount of concrete laid for each platform was 47⅛ cubic yards. The top surfaces of the platforms have been made in granolithic finish and two sets of movable steps provided for each.

In constructing the magazine 36 cubic yards of concrete was placed.

Money statement.

June 30, 1898, amount allotted during fiscal year	$18,000.00
June 30, 1898, amount expended during fiscal year	1,963.70
July 1, 1898, balance unexpended	16,036.30
July 1, 1898, outstanding liabilities	133.94
July 1, 1898, balance available	15,902.36

Allotments.

Act March 9, 1898, allotment of April 6, 1898	$12,000.00
Act March 9, 1898, allotment of April 13, 1898	6,000.00
Total	18,000.00

Platforms for four 8-inch rifles on parapet.—This work is of a temporary nature, and the construction of these platforms was not contemplated in the approved project.

The first of the four platforms was ordered to be constructed on April 4, 1898, at a cost of $2,000. The site selected was that occupied by a 15-inch smooth-bore gun in the apex of the angle of Bastion No. 3. The gun and carriage of this piece, as also the guns and carriages of two 8-inch converted rifles, were necessarily dismounted. The platform of the former was removed and 60 cubic yards excavated for the foundation of the 8-inch rifle platform. Sixty-nine cubic yards of concrete was necessary to construct the platform.

The gun and carriage had been mounted on June 15, 1898.

By telegram of April 16, 1898, three additional platforms for the same armament were authorized, and on April 28, 1898, $6,000 was allotted for the work of construction.

Before the foundations for the platforms could be laid the removal of five old platforms and the excavation of 180 cubic yards of material was necessary.

After the erection of required sheathing 255 cubic yards of concrete was placed for the platforms, or an average of 85 cubic yards for each.

By June 15, 1898, the guns and carriages had been mounted on the platform located in Bastion No. 2 and on one of the other platforms on front 3. At the close of the fiscal year the carriage for the fourth gun was in position.

Money statement.

June 30, 1898, amount allotted during fiscal year	$8,000.00
June 30, 1898, amount expended during fiscal year	3,065.83
July 1, 1898, balance unexpended	4,934.17
July 1, 1898, outstanding liabilities	7.50
July 1, 1898, balance available	4,926.67

Allotments.

Act March 9, 1898, allotment of April 4, 1898	$2,000.00
Act March 9, 1898, allotment of April 28, 1898	6,000.00
Total	8,000.00

Reinforcing water-battery magazines.—These magazines are located one at each end of the water battery and serve all the guns therein. They were unprotected on the channel front, except by their masonry walls, and were consequently liable to damage during an attack.

The work done in giving the additional protection was the placing of 263 cubic yards of sand in front of them, building a retaining wall of old concrete, and in addition constructing cribs at each and filling same with 250 bags of sand.

It is intended to cover the sand protection with clay, soil, and sod, which will require about 30 cubic yards each of clay and soil and 200 square feet of sod.

Money statement.

June 30, 1898, amount allotted during fiscal year	$300.00
June 30, 1898, amount expended during fiscal year	143.44
July 1, 1898, balance unexpended	156.56

Allotment.

Act March 9, 1898, allotment of April 28, 1898	$300.00

Torpedo defense, Hampton Roads, Virginia.—Prior to the receipt of telegraphic instructions, on April 22, 1898, to plant mines, all the cable required for one grand group had been run out from the casemate and laid in Hampton Roads, but this had become so entangled that only eight mines could be properly spaced in the leads when instructions were received. The first mines were planted on Sunday, April 24, 1898.

The depth of water, varying direction of the tidal flow on the surface and at the bottom, and weather conditions rendered the planting of the mines by the method prescribed in the Torpedo Manual impossible, and the mines were planted with single leads, in single or double skirmish lines, for automatic action. The number of mines on each line varied from 6 to 15.

In all 108 mines have been planted. Two groups of three mines each, for judgment firing, were planted in the open channel 32 feet below the surface of the water.

The regulations for the navigation of the mined field were promulgated on April 24, 1898, in accordance with instructions, and on April 27, 1898, were modified to permit navigation between the hours of 4 a. m. and 8 p. m.

Repairs to the mine field have been a daily necessity, due to natural causes in some instances, but in most part due to the carelessness and indifference of masters of vessels passing through the field. The greatest source of trouble came from broken mine leads and from leaks, the latter probably due to the chafing of the insulation from the cable by contact with the mooring rope, on account of the rotary motion given

the mine by the tidal current and by being moved about by high seas and swells from passing steamers. The broken leads occurred from contact with boat propellers, and in one instance a mine was sunk, the casing being cut to such an extent that the entire charge of dynamite had run out when the mine was recovered.

Fishing skiffs, in pairs, lashed together by stanchions at each end, were used in planting the mines. In planting the double boat was anchored, a sounding taken and the anchor suspended from one of the crosspieces, the mooring rope shackled to the mine, which was then dropped overboard and put in position by cutting the rope suspending the anchor. In favorable weather six to eight mines were planted during each tide by this method.

In the casemate near Redoubt A electric batteries for firing, testing, and signaling, and transformer and oil engine for charging the storage batteries, were set up.

At the close of the fiscal year the foundation had been laid for the 25-horsepower oil engine to be used in operating a 36-inch projector and the engine set up.

Surplus cable has been stored in the tank constructed for the purpose. The ends of this cable were insulated before being stored.

Three tugboats have been constantly on duty patrolling the mine field and planting mines since April 24, 1898.

Money statement.

June 30, 1898, amount allotted during fiscal year	$27,000.00
June 30, 1898, amount expended during fiscal year	9,329.24
July 1, 1898, balance unexpended	17,670.76
July 1, 1898, outstanding liabilities	15,802.06
July 1, 1898, balance available	1,868.70

Allotments.

National Defense, act March 9, 1898:	
Allotment of March 18, 1898	$1,000.00
Allotment of April 4, 1898	6,000.00
Allotment of April 28, 1898	10,000.00
Torpedoes for Harbor Defense, January 1, 1899:	
Act May 4, 1898, allotment of June 11, 1898	10,000.00
Total	27,000.00

4 J.

DEFENSES OF THE COAST OF NORTH CAROLINA.

Officer in charge, Capt. William E. Craighill, Corps of Engineers; assistants, Lieut. Edgar Jadwin, Corps of Engineers, until October 12, 1897, and Lieut. John C. Oakes, Corps of Engineers, since September 30, 1897. Division Engineer, Brig. Gen. Peter C. Hains, U. S. Volunteers, Colonel, Corps of Engineers.

Defense at the entrance to Beaufort Harbor.—After the commencement of the war with Spain the carriages of two 100-pounder Parrott rifles were put in fairly good order, and one of the guns was moved to a new and more advantageous position. Two 10-inch S. B. mortars were mounted on the covered way and a magazine arranged for them. Two platforms for the same mortars were also arranged on the parade of the fort. Splinter-proof traverses were built for the protection of the guns and mortars.

Money statement.

NATIONAL DEFENSE, ACT MARCH 9, 1898.

Amount allotted	$3,000.00
June 30, 1898, amount expended during fiscal year	2,464.55
July 1, 1898, balance unexpended	535.45
July 1, 1898, outstanding liabilities	318.80
July 1, 1898, balance available	216.65

Fort at Southport, near the mouth of Cape Fear River.—This consists of a small reservation with one substantial brick building on it. Nothing has been done to this fort except some small repairs to the building, which is used for various purposes of the Engineer Department.

Summons in case of suits for possession of the reservation were served on the officer in charge by parties claiming to have acquired rights to the property. Copies were forwarded to the Office of the Chief of Engineers May 31, 1898, and are now in the hands of the United States district attorney.

Money statement.

July 1, 1897, balance unexpended	$225.00
June 30, 1898, amount expended during fiscal year	225.00

Defense at the mouth of Cape Fear River.—Near the foot of the glacis the battery for four 8-inch rifles on disappearing carriages, model 1894, was, at the beginning of the fiscal year, in progress under contract with John L. Grim, of Philadelphia, for three emplacements. The contract time expired on December 1, but was extended until December 31.

The guns and carriages for three emplacements were mounted by hired labor in January and February, and the three emplacements turned over to the artillery garrison in March.

The fourth emplacement for one 8-inch B. L. rifle on disappearing carriage, model 1896, was built under the appropriation for "National Defense," act of March 9, 1898, and was completed, except some of the smaller details. The armament was received and mounted during the progress of the work. This emplacement is on the right of the three previously built. Between it and the older work a platform and magazine for a 5-inch rapid-fire gun on balance-pillar mounting was arranged for.

The masonry and part of the sand parapet of an emplacement for a 4.72-inch rapid-fire gun on a pedestal mount was built on the parapet of the old fort under appropriation for "National Defense." One of the bomb-proof rooms of the fort was strengthened and arranged for a magazine.

This emplacement is adjacent to the battery for two 12-inch guns under construction and will be completed in connection with that battery.

A battery for two 12-inch rifles on barbette nondisappearing carriages was commenced under the appropriation for "National Defense," in May.

At the close of the year the platforms had been completed, necessary plant installed, the excavation for the masonry completed, and the masonry advanced to about the level of the tops of the magazines.

Plans were prepared and submitted for approval for a battery of eight 12-inch B. L. mortars, but work had not commenced at the end of the year.

Money statements.

GUN AND MORTAR BATTERIES—EMPLACEMENTS. (CONTRACT.)

July 1, 1897, balance unexpended	$106,693.45
Amount transferred to "Superintendence" account	3,000.00
	103,693.45
June 30, 1898, amount expended during fiscal year	101,653.06
July 1, 1898, balance unexpended	2,040.39
July 1, 1898, outstanding liabilities	.38
July 1, 1898, balance available	2,040.01

Superintendence.

July 1, 1897, balance unexpended	$3,987.57
November, 1897, transferred from contract account	3,000.00
	6,987.57
June 30, 1898, amount expended during fiscal year	6,323.19
July 1, 1898, balance unexpended	664.38
July 1, 1898, outstanding liabilities	2.33
July 1, 1898, balance available	662.05

Mounting three 8-inch guns and carriages.

July 12, 1897, amount allotted	$3,000.00
June 30, 1898, amount expended during fiscal year	2,962.26
July 1, 1898, balance unexpended	37.74
July 1, 1898, outstanding liabilities	2.50
July 1, 1898, balance available	35.24

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

One 8-inch gun emplacement.

Amount allotted	$40,000.00
June 30, 1898, amount expended during fiscal year	39,973.69
July 1, 1898, balance unexpended	26.31
July 1, 1898, outstanding liabilities	1,697.10
July 1, 1898, balance available	*—1,670.79

Mounting R. F. guns.

Amount allotted	$3,000.00
June 30, 1898, amount expended during fiscal year	2,652.38
July 1, 1898, balance unexpended	347.62
July 1, 1898, outstanding liabilities	2,012.80
July 1, 1898, balance available	†—1,665.18

Two 12-inch gun emplacements.

Amount allotted	$90,000.00
June 30, 1898, amount expended during fiscal year	60,818.96
July 1, 1898, balance unexpended	29,181.04
July 1, 1898, outstanding liabilities	36,557.77
July 1, 1898, balance available	‡—7,376.73

Submarine mines.—The torpedo casemate was fitted up for service, the operating apparatus received and set up, a chart of the harbor on

* Covered by an indebtedness due from one R. F. gun emplacement.
† Covered by amount allotted since close of fiscal year.
‡ Covered by additional allotment subsequent to June 30, 1898.

zinc prepared, base-end stations for judgment firing arranged and connected by telephone with the casemate, and a grand group of torpedoes received, loaded, and planted in the channel.

The sand covering of the casemate had been blown away by the wind to a considerable extent. This was restored and covered with sod from the marsh as a protection.

The entrance to the casemate was indirectly exposed to fire through open rooms and passages of the old works. Sand was placed against the exposed ends of these.

Money statements.

TORPEDOES FOR HARBOR DEFENSE.

July 1, 1897, balance unexpended	$350.00
March 1, 1898, amount allotted	150.00
	500.00
June 30, 1898, amount expended during fiscal year	236.68
July 1, 1898, balance unexpended	263.32
July 1, 1898, outstanding liabilities	21.44
July 1, 1898, balance available	241.88

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

Amount allotted	$10,450.00
June 30, 1898, amount expended during fiscal year	8,032.55
July 1, 1898, balance unexpended	2,417.45
July 1, 1898, outstanding liabilities	1,991.32
July 1, 1898, balance available	426.13

REPORT OF LIEUT. JOHN C. OAKES, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Fort Caswell, N. C., July 6, 1898.

CAPTAIN: I have the honor to submit the following report of operations at the mouth of Cape Fear River, North Carolina, for the year ending June 30, 1898.

These operations include the following emplacements:

1. *The completion of three 8-inch B. L. rifles.*—This work was begun last year under contract and at the beginning of this year (fiscal) one emplacement was partially completed, 2,286.5 cubic yards of concrete being in place, or about one-half of total amount for that emplacement. The contract expired December 1, 1897; was extended one month. For plant and methods see report of Lieut. Edgar Jadwin, Corps of Engineers, from this office, dated Wilmington, N. C., June 30, 1897. In connection with this contract a shell road was built from the dock to battery, about one-half mile in length, at the following cost to the Government:

Embankment: 3,682.9 cubic yards at 27 cents and 798.61 cubic yards at 13 cents		$1,098.20
Turfing, 2,964.5 square yards at 19 cents		563.26
Shells, 7,878.75 bushels at 4 cents		315.13
Total		1,976.59
The sand parapet and ground behind battery were turfed—4,852.7 square yards, at 24 cents		1,164.65
Nine cisterns were built; capacity, 49,500 gallons; cost, $65 each		585.00
An electric light plant was installed:		
Material cost	$2,313.62	
Labor	126.84	
		2,440.46

Upon completion of this work the plant was removed and stored, and the battery made ready to be turned over to the artillery.

2. *Completion of the fourth emplacement for an 8-inch B. L. rifle.*—On March 18 an order was received at this office to begin work on a fourth emplacement for 8-inch B. L. rifle and to begin mixing concrete for platform by hand. Work was begun immediately both on plant and platform, and work continued day and night until completed. On March 25 the platform was finished. Began mixing concrete in mixer on March 29, and finished battery, with exception of trolleys, railings, and steps, May 12, 1898.

3. *The construction of two emplacements, one for 4.7-inch R. F. gun and one for 5-inch R. F. gun.*—The 5-inch R. F. emplacement was incorporated in the fourth emplacement for 8-inch B. L. rifle, and was completed when that emplacement was completed.

The 4.7-inch R. F. emplacement was built on the parapet of the old fort and the concrete mixed by hand. For a magazine for this emplacement one of the casemates of the old fort was utilized, building the emplacement over it. The guns for these two emplacements have not yet been received. The excavation for this emplacement was begun April 8, stopped April 12, begun 19th, finished, and concrete begun on 21st, and concrete finished April 28, 1898.

4. *Partial construction of two emplacements for 12-inch B. L. rifles, mounted "en barbette."*—Before the work on the fourth 8-inch emplacement was completed orders had been received to construct two emplacements for 12-inch B. L. rifles to be mounted en barbette, platforms to be built by hand and immediately on receipt of order. Work on first platform was begun May 11, 1898, finished May 19; second platform begun May 23, completed May 27, 1898.

Upon completion of fourth emplacement the plant was moved directly to the old fort and installed as rapidly as place could be made by cutting down the parapet and filling ditch. The new emplacements extend across the old fort and both parapets had to be cut down.

Excavation was performed by barrows, dump cars, skips, and orange-peel bucket swung with derricks. This was begun May 23 and finished June 24. Plant was completed and concrete mixed June 8, 1898. Up to and including June 30, 1898, 4,070 cubic yards of concrete and 400 cubic yards of large stone had been put in place. Maximum amount of concrete placed in twenty-four hours, 352 cubic yards. It is estimated that concrete work on this battery will be completed on or before July 25, 1898.

5. *Mounting four 8-inch B. L. rifles.*—Three of these guns were mounted on emplacements that were finished, and the fourth was mounted while the emplacement was being built. The three were slid on skids from the parapet to their place above the trunnion beds and then lowered into position. The fourth was jacked up from the loading platform and slid into position and lowered as before. All of the carriages were landed on the loading platforms. The guns arrived before the work was finished, and were placed on parapet. Carriages arrived and were landed on wharf January 4 to 8, 1898, inclusive. Work of mounting first gun was begun January 10 and completed January 28. Orders were received January 28 to hasten work as much as possible, and work on second gun was begun immediately and finished February 3, 1898. Work on third gun was begun January 29 and finished February 5, 1898. The fourth gun was mounted as soon as it and the carriage were received and while the concrete work on the parapet was being carried on.

Mounting was begun April 18 and completed April 25, 1898.

The two R. F. guns and two 12-inch B. L. rifles have not yet been received, although the platforms are ready for them.

6. *Torpedo work.*—One grand group of buoyant torpedoes has been received and put in position for protection of harbor. The material was stored and apparatus arranged in casemate with telephonic connection to the base end stations.

7. *Miscellaneous.*—In connection with the above-described operations, and for the purpose of facilitating them, a telegraph line was run from the engineer office to Southport and connecting with line to Wilmington, N. C. Telephones have been installed at different points, thereby facilitating the work greatly. A sand fence was constructed to build up the breach between the old fort and the 8-inch battery, and has been partially successful. The expected arrival of the two 12-inch guns made necessary the construction of a more substantial dock than that now in use for landing materials. The dock was begun June 4 and will probably be completed by July 20, 1898.

Very respectfully, your obedient servant,

JOHN C. OAKES,
Second Lieut., Corps of Engineers, U. S. A.

CAPT. W. E. CRAIGHILL,
Corps of Engineers, U. S. A.

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4 K.

DEFENSES OF THE COAST OF SOUTH CAROLINA.

Officers in charge, Maj. Frederic V. Abbot, Corps of Engineers, until September 15, 1897; Lieut. Edwin R. Stuart, Corps of Engineers, from September 15 to October 9, 1897; and Maj. Ernest H. Ruffner, Corps of Engineers, from October 9, 1897; assistants, Lieut. Edwin R. Stuart, Corps of Engineers, until September 15, 1897, and from October 9 to November 10, 1897; Lieut. Harley B. Ferguson, Corps of Engineers, from September 30, 1897, to April 11, 1898; Lieut. Charles Keller, Corps of Engineers, from April 11, 1898; and Lieut. Edward H. Schulz, Corps of Engineers, from May 20, 1898. Division Engineer, Brig. Gen. Peter C. Hains, U. S. Volunteers, Colonel, Corps of Engineers.

DEFENSES OF CHARLESTON, SOUTH CAROLINA.

Mortar battery.—For history prior to June 30, 1896, see page 508; for description of well-point method of controlling water in foundation excavations, see pages 509 to 512; for costs to that date, see page 512; and for description and history of quarry, page 513, Annual Report of the Chief of Engineers for 1896.

WORK OF PAST YEAR.

The concrete ramps in the pits were finished, their surface having a granolithic covering 3 inches thick. All the floors were put in. The doors for the two magazines, one door for the entrance of the dynamo room, one door for the latrine, were built. One light panel door was built for the entrance of the long passage to the relocator room, and a

gate for the cross passage. From November, 1897, to April, 1898, no work was done by the Engineer Department, as settlement still continued. Work was resumed in April. The mortars were releveled and the index circles were set, the concrete work around them being completed. The ramp in the rear of the northeast pit was also finished, the doors hung, and all work completed except the leveling off of the slopes. The remaining eight mortars were received and mounted by the artillery and the azimuth pointers set, the data having been furnished by the engineers. The battery is now ready for use, and is in the charge of the artillery.

The experimental planting of the slopes with grass and oats did not prove successful, and nothing has been done looking to holding the mud covering. This may be gradually smoothed down with the passage of time, and it is not impossible that spontaneous growth of grass may spring up on it.

Settlement has not entirely ceased. From July 1, 1897, to June 18, 1898, there was settlement to the amount of 0.21 of a foot at the south end of the main passage, 0.24 at the north end, and 0.26 at the middle. From February 28 to June 18 there was 0.05 at the south end, 0.05 at the north end, and 0.07 at the middle. The total settlement from the beginning is 1.58 feet at the south end, 1.43 feet at the north end, and 1.40 feet in the middle.

The cable tank located at the site of this battery was completed, and is ready for use.

Money statement.

July 1, 1897, balance unexpended	$5,877.09
September 9, 1897, amount allotted	7,000.00
	12,877.09
June 30, 1898, amount expended during fiscal year	8,756.61
July 1, 1898, balance unexpended	4,120.48
July 1, 1898, outstanding liabilities	50.00
July 1, 1898, balance available	4,070.48

Amounts and dates of all allotments made for this battery.

Date of act.	Date of allotment.	Amount.
March 2, 1895	Feb. 14, 1896	$60,000
June 6, 1896	Aug. 11, 1896	50,000
Do	Oct. 5, 1896	50,000
Do	Dec. 16, 1896	12,000
Do	Sept. 9, 1897	7,000
Total		179,000

Ten-inch battery.—Work under the continuing contract of Jacob Friday & Sons for three emplacements at this battery was continued, and finally closed October 18, 1897. There was considerable delay in completing the lifts and cranes. Work on these extended into December, but as Messrs. Jacob Friday & Sons were not responsible for the delay, their contract was closed at the time stated. On August 10, 1897, bids were called for to complete the battery, the necessary authority having been obtained from the Department. These bids were opened on September 9 and the contract awarded to the lowest bidder,

Messrs. Sanford, Brooks & Bonsal, of Baltimore, Md. The constructive commencement of work under this contract was on November 2, from which time the rent of plant was charged. Actual work began December 9 on the sea wall, and the contract was completed, constructively, on March 23, 1898. At that time it was necessary for the United States to use its plant under the appropriation for "National Defense." A few minor portions of the work remained to be done, and these were completed in April.

The work on the artesian well was prosecuted under some difficulties by Mr. E. F. Joyce, the contractor, and the well finally completed to the depth required by the contract on May 8, 1898. A depth of 1,308 feet was obtained. There is a flow of water at the top of the pipe of from two to three gallons per minute, and although the well is a disappointment as to the quantity and quality of water delivered, it forms a valuable addition to the water supply.

During the fiscal year all of the guns and carriages for the battery were received, and have all been mounted by the artillery. The battery is complete, except the electric-lighting plant, not provided for in the original plans. Steps have been taken to build two cisterns for the water supply of this battery.

Money statement.

July 1, 1897, balance unexpended	$94,028.77
August 26, 1897, amount allotted	10,000.00
	104,028.77
June 30, 1898, amount expended during fiscal year	104,028.77

Amounts and dates of all allotments made for this battery.

Date of act.	Date of allotment.	Amount.	Remarks.
June 6, 1896	Aug. 31, 1896	$500	Plans and drawings.
Do	Dec. 1, 1896	9,500	Supervision.
March 3, 1897	Mar. 26, 1897	150,000	Contract payments.
Do	Aug. 26, 1897	10,000	Do.
Do	Nov. 16, 1897	65,000	Contract payments and supervision.
Total		235,000	

Lists of contracts in force.

Contract for—	Name of contractor.	Date of approval.	Date of beginning.	Date of completion.
Constructing three emplacements for 10-inch battery.	Jacob Friday & Sons	Jan. 21, 1897	Feb. 1, 1897	Dec. 1, 1897
Constructing one emplacement for 10-inch battery.	Sanford, Brooks & Bonsal	Oct. 21, 1897	Nov. 2, 1897	Mar. 23, 1898
Boring artesian well	E. F. Joyce	Dec. 26, 1896	Jan. 14, 1897	May 8, 1898

Abstract of proposals received in response to advertisement dated August 10, 1897, and opened September 9, 1897, for furnishing materials and constructing a gun emplacement.

	Simons & Mayrant.	Jacob Friday & Sons.	Sanford, Brooks & Bonsal.	S. F. Leonard.
Large stone ..... per ton..	$2.50	$2.25	$2.25	$2.45
Broken stone ..... do....	2.75	2.50	2.30	2.64
Pon Pon gravel ..... per cubic yard..	1.30	1.05	1.25	1.20
Sand in bins ..... do....	.25	.40	.25	.97
American Portland cement ..... per barrel..	2.40	2.85	2.20	1.99
American natural cement ..... do....	1.40	1.05	1.00	.85
Anchor bolts (1) ..... each..	100.00	75.00	100.00	115.65
Steel I-beams ..... per ton..	58.00	52.00	45.00	57.76
Corrugated iron ..... per pound..	.05	.03½	.04	.04 32/100
Drain cover ..... per linear foot..	.80	.75	.55	.80 76/100
Iron stairways 4 feet wide ..... per step..	12.00	12.00	10.50	4.20
Iron stairways 4½ feet wide ..... do....	12.75	13.00	11.00	4.68
Iron stairways 6 feet wide ..... do....	16.00	15.00	13.50	6.30
Cast-iron columns (6) ..... for lot..	125.00	90.00	125.00	280.41
Iron landing ..... for job..	40.00	40.00	75.00	10.00
Small doors and hinges ..... each..	63.00	55.00	50.00	27.32
Large door and hinges ..... do....	70.00	80.00	65.00	38.19
Brass pipe ..... per pound..	.22	.20	.50	.40 38/100
Trolley system ..... for job..	300.00	240.00	150.00	333.24
Ammunition hoist and cranes ..... for lot..	1,500.00	1,600.00	1,700.00	235.00
Concrete mixing ..... per cubic yard..	1.52	1.60	1.40	1.56
Setting base ring ..... per ring..	300.00	200.00	150.00	60.00
Sand embankment ..... per cubic yard..	.18	.25	.25	.60
Excavation ..... do....	.18	.25	.25	.40
Fertile earth ..... do....	1.00	1.00	.75	1.75
Total amount of bid	78,705.50	70,969.50	66,612.80	73,196.78

On May 17 an allotment for the construction of two cisterns was made. The cisterns to be constructed will contain 30,000 gallons each. At the end of the fiscal year no work had been done.

Money statement.

May 17, 1898, amount allotted $1,610
July 1, 1898, balance unexpended 1,610

Amount and date of all allotments for this purpose.

Date of act.	Date of allotment.	Amount.
March 3, 1897	May 17, 1898	$1,610.00

Twelve-inch battery.—On March 17, 1898, telegraphic instructions were received from the Chief of Engineers to begin work on one emplacement for a 12-inch disappearing rifle on United States disappearing carriage model of 1896. The gun platform was ordered completed as early as practicable. Orders for material were given out as soon as possible, and some of the plant was moved to the site from another work. Bins were built and cement shed and mixer frame erected. Concrete work actually began on May 3. The anchor bolts were set with a templet, as the base rings could not be obtained. The upper portions of these anchor bolts were surrounded with iron pipe somewhat larger than the bolt, in order to admit of a little springing if the base ring does not fit exactly. On May 14 the platform was ready for the base ring. This is the northern of the two 12-inch emplacements designed for the battery. By the Department letter, dated April 25, 1898, the immediate construction of another emplacement was ordered.

This is to be prepared for a barbette carriage, the plans of the disappearing gun being modified to suit the change. It constitutes the southern emplacement. At the end of the fiscal year the gun platform had not been finished, but had reached the level of the bottom of the anchor bolts. These platforms were built of Portland cement concrete, while the balance of the battery is built of American natural cement.

The foundations of the north emplacement were finished and most of the walls and parapet raised to the level of the roof. The southern emplacement is well advanced. The natural ground under a portion of this last was low and has been brought up to reference 10 (10 feet above mean low water) with sand and pieces of concrete from an old magazine which had to be removed. No guns or carriages have yet been received for this battery. About 2,500 cubic yards of natural cement concrete have been put in place, and 400 cubic yards of Portland. The concrete work is about 0.3 finished. Arrangements for the purchase of all-steel I-beams, corrugated metal, ammunition hoists, and trolley systems were made, and a portion of the material delivered. The doors and cranes have not yet been provided for. This work is being carried on under many difficulties. The workmen must live on the island, and are carried to and from the fort daily. The wharf where material is unloaded is exposed, and often there is a considerable sea running, making unloading difficult. The site is so contracted that it is difficult to store material where it will not interfere with the work of construction. The Government plant and that purchased from the contractors, Sanford, Brooks & Bonsal, were both run down when work began, and considerable inconvenience and some loss are thereby entailed. Building sand for concrete is being supplied from a fresh-water river by small vessels because beach sand is not readily obtainable. The irregularity of the arrival of these vessels interferes somewhat with the work of construction.

These operations were carried on under the appropriation for "National Defense," act of March 9, 1898.

Money statements.

EMPLACEMENT FOR DISAPPEARING GUN.

March 18, 1898, amount allotted	$25,000.00	
June 11, 1898, amount allotted	25,000.00	
		$50,000.00
June 30, 1898, amount expended during fiscal year		29,166.77
July 1, 1898, balance unexpended		20,833.23
July 1, 1898, outstanding liabilities		10,000.00
July 1, 1898, balance available		10,833.23

EMPLACEMENT FOR NONDISAPPEARING GUN.

April 25, 1898, amount allotted	$20,000.00	
June 11, 1898, amount allotted	20,000.00	
		$40,000.00
June 30, 1898, amount expended during fiscal year		5,390.00
July 1, 1898, balance unexpended		34,610.00
July 1, 1898, outstanding liabilities		10,000.00
July 1, 1898, balance available		24,610.00

Amounts and dates of all allotments for this battery.

Date of act.	Date of allotment.	Amount.	Remarks.
March 9, 1898	Mar. 18, 1898	$25,000	Emplacement disappearing gun.
Do	Apr. 25, 1898	20,000	Emplacement nondisappearing gun.
Do	June 11, 1898	20,000	Do.
Do	do	25,000	Emplacement disappearing gun.
Total		90,000	

List of contracts in force.

Contract for—	Name of contractor.	Date of approval.	Date of beginning.	Date of completion.
Furnishing and installing ammunition hoists and trolley systems.	New Jersey Foundry and Machine Co.	July 13, 1898	June 15, 1898	July 20, 1898

Abstract of proposals for furnishing and installing ammunition hoist and trolley systems received in response to advertisement dated May 21, 1898, and opened May 31, 1898, by Maj. E. H. Ruffner, Corps of Engineers.

	Charleston Iron Works.	New Jersey Foundry and Machine Co.	Link Belt Engineering Co.
Ammunition hoist	$3,000	$1,950	$3,050
Trolley (first design)		775	
Trolley (second design)		850	
Trolley (third design)		730	

4.7-inch rapid-fire guns.—By letter from the Office of the Chief of Engineers dated March 19, 1898, instructions were given to make arrangements for mounting two 4.7-inch rapid-fire guns at the earliest practicable date, with funds allotted from the appropriation for "National Defense," act of March 9, 1898.

Preparations were started at once, using a part of the plant which had been used by contractors Sanford, Brooks & Bonsal in the construction of the fourth emplacement of the 10-inch battery, and which had been purchased by the United States.

Considerable work of excavation and blasting of old masonry was necessary for these emplacements. Concrete mixing began April 12. By May 1 these two emplacements were completed and one magazine between them was finished, except the roof. On June 30 all of this work was completed, and a gallery excavated. The walls and arch of this gallery were nearly completed on that date. It connects the rear of the rapid-fire gun emplacements with the main magazine, which is thus available for storage and for service of these guns.

Money statement.

April 6, 1898, amount allotted	$6,000.00
June 30, 1898, amount expended during fiscal year	4,420.67
July 1, 1898, balance unexpended	1,579.33
July 1, 1898, outstanding liabilities	1,500.00
July 1, 1898, balance available	79.33

Amount and date of allotment for this work.

Date of act.	Date of allotment.	Amount.
March 9, 1898	Apr. 6, 1898	$6,000

Six-inch rapid-fire guns.—On April 25, 1898, instructions were received from the Chief of Engineers to construct one emplacement for a 6-inch rapid-fire gun, and an allotment of $8,000 was made therefor from the appropriation for "National Defense," act of March 9, 1898.

At the end of the fiscal year no work had been done.

Money statement.

April 25, 1898, amount allotted	$8,000.00
July 1, 1898, balance unexpended	8,000.00

Amount and date of all allotments for this purpose.

Date of act.	Date of allotment.	Amount.
March 9, 1898	Apr. 25, 1898	$8,000

Preservation and repair of fortifications.—On June 14, 1897, an allotment was made from the appropriation for "Preservation and Repair of Fortifications" to be applied to the construction of gun platforms in emplacements Nos. 5, 6, 7, and 8 at the old fort.

Under this allotment the guns and carriages mounted upon old rotten wooden platforms at emplacements 5, 6, 7, and 8 have been removed. Concrete emplacements had been completed at Nos. 6 and 7, and two of the above-mentioned guns (15-inch smoothbore) have been mounted on these. Emplacement No. 8 was nearly completed. The work of mounting the 15-inch guns was mainly done by the artillery.

Money statement.

July 1, 1897, balance unexpended	$1,800.00
June 30, 1898, amount expended during fiscal year	1,800.00

Amount and date of allotment for this work.

Date of act.	Date of allotment.	Amount.
March 3, 1897	June 14, 1897	$1,800

DEFENSES OF PORT ROYAL, SOUTH CAROLINA.

Rapid-fire guns.—On April 6, 1898, instructions were received from the Chief of Engineers to construct emplacements for two 4.7-inch rapid-fire guns. The emplacements are about 400 feet from high-water mark, and top of parapet is 25 feet above mean low water. Work was done by hired labor. Crushed stone was bought in Columbia, S. C., and shipped by rail to Charleston, S. C., and thence by water on lighters. The lighters were beached about 300 feet from high-water mark, a temporary trestle built, and the stone wheeled by barrows to the site. Five hundred barrels of Rosendale cement were brought from

Charleston by water and handled like crushed stone, and covered by a temporary cement shed. A well was dug near the site and water was conveyed by a trough to a movable tank near mixing platforms. Concrete composed of 1 part Rosendale cement, 2 parts sand, and 4½ parts crushed stone was mixed by hand on platforms built around the emplacements.

The first concrete was mixed April 28 and continued, with many delays from lack of lumber and cement, until June 30. The two gun blocks are complete. The central magazine is finished, and flank magazine built to roof level. The guns with their carriages and armor were brought down on lighters from Port Royal, landed on the beach, moved to the site, and mounted. Guns were ready for action June 24. Total number of cubic yards of concrete placed 530, using 718 barrels Rosendale cement and 16 barrels of Portland.

The work was done under the appropriation for "National Defense," act of March 9, 1898.

Money statement.

April 6, 1898, amount allotted	$6,000.00
June 30, 1898, amount expended during fiscal year	5,550.91
July 1, 1898, balance unexpended	449.09
July 1, 1898, outstanding liabilities	449.09

Amount and date of all allotments made for this purpose.

Date of act.	Date of allotment.	Amount.
March 9, 1898	Apr. 6, 1898	$6,000

Siege battery.—On April 11, 1898, instructions were given by the Chief of Engineers to select sites for a temporary battery to consist of one 5-inch B. L. siege gun and one 7-inch B. L. siege howitzer. The site selected was the northwest corner of the reservation, distant about 1,100 feet from rapid-fire emplacements. Parapet was to have a top thickness of 15 feet of sand in front of guns, and slope of 2 to 1 from thence to natural surface of the ground. The flank protection was practically the same. The magazines were composed of 12 by 12 inch pine bents, bolted together, calked, and tarred. Interior dimensions of magazines were 7 feet on bottom, 5½ feet on top, 12 feet long, and 6½ feet high.

Work started on this battery May 2, and was completed May 12. The two magazines were coated with tar and covered with 6 feet of earth. One 5-inch siege gun and one 7-inch howitzer were brought from Port Royal on lighter, and everything was ready for mounting them, when orders were received to ship them to Tampa, Fla. Since that time two light 12 pounders have been received, and mounted on wooden platforms, so as to fire over parapets. One of the magazines is used as a mining casemate and the other for storage purposes.

The funds were allotted from the appropriation for "National Defense," act of March 9, 1898.

Money statement.

May 18, 1898, amount allotted	$2,000.00
June 30, 1898, amount expended during fiscal year	701.63
July 1, 1898, balance unexpended	1,298.37
July 1, 1898, outstanding liabilities	1,298.37

Date and amount of all allotments for this purpose.

Date of act.	Date of allotment.	Amount.
March 9, 1898	May 18, 1898.	$2,000

Ten-inch battery.—On April 6, 1898, instructions were given by the Chief of Engineers to obtain authority from the owner of the property for temporary occupation of land at Port Royal for two 10-inch guns on disappearing carriages. The land has since been purchased and paid for by the United States.

This battery is located between the rapid-fire and the siege batteries, and the front slope at the nearest point is 150 feet from high-water mark. Elevation of magazine floors is 13 feet above mean low water. Surface of ground at the site is about 3 feet above bottom of concrete. Borings near the site show sand, shell, and thin strata of mud to depth of 50 feet. The contracted nature of the site necessitated the location of the battery nearer high-water mark than was deemed advisable, and will probably require the building of a riprap breakwater to prevent the encroachment of the sea. An informal contract was made with Mr. B. F. Kramer to build a wharf with head 50 by 30 feet and a pile trestle approach as far in to the beach as was deemed necessary to join with framed trestle work erected by hired labor. Mr. W. R. Bonsal, under an informal agreement, built a cement shed 50 by 150 feet, stone and sand bins 40 by 140 feet, and a quarter house for employees. He also furnished crushed and large stone under an informal agreement. Stone is brought by rail from Greenwood, S. C., to Port Royal, where it is loaded on lighters by the railroad company. Two tugs hired by the United States tow these lighters to the wharf, where a derrick capable of handling 5 tons transfers it to rock cars on the wharf. A small locomotive owned by the United States pulls the cars to the foot of the incline leading to the bins, and a hoisting engine mounted on top of the bins pulls them up to the dumping place with a wire cable. Hunt dump cars are used under the bins, and receive the charge of sand and broken stone through gates in the bottom operated by means of a lever. These cars are raised by an elevator (operated by the mixing engine) to top of mixer, where the charge is dumped into a hopper leading to a 4-foot cubical concrete mixer. The lower portion of this hopper is movable, and swings out of the way when the mixer starts. After the charge has been turned at least sixteen times, it is dumped into an iron dump tub seated on a small car under the mixer. The charge is pulled by mules to the traveling derrick and swung by it to any place desired within a radius of 40 feet. The traveling derrick moves on a track just outside of the casing for front of the battery and parallel to the axis of battery. Water for the work is supplied by two rows of well points driven 10 feet apart under the bins and connected with a Knowles duplex pump, which forces it to a tank about 30 feet above high-water mark. This plant was ready for work on June 30, with the exception of two turntables for Hunt track and one steam pump.

While work of establishing plant was in progress, two gun blocks for 10-inch rifles were completed by hand mixing. As base rings were not on hand a templet was used, constructed according to drawings of base rings.

The top 2 feet of anchor bolts were encased by 3-inch pipe, so as to allow the bolts to be sprung if necessary. Four hundred and fifty-four

cubic yards of concrete were placed in these blocks, using 339 barrels of Rosendale and 230 barrels of Portland cement.

This work was done under the appropriation for "National Defense," act of March 9, 1898.

Money statement.

April 29, 1898, amount allotted	$25,000.00
June 11, 1898, amount allotted	64,000.00
	89,000.00
June 30, 1898, amount expended during fiscal year	5,745.20
July 1, 1898, balance unexpended	83,254.80
July 1, 1898, outstanding liabilities	20,000.00
July 1, 1898, balance available	63,254.80

Amount and dates of all allotments for this purpose.

Date of act.	Date of allotment.	Amount.
March 9, 1898	Apr. 29, 1898	$25,000
Do	June 11, 1898	64,000

Eight-inch rifles.—Instructions were received from the Chief of Engineers April 27, 1898, to construct a temporary battery to contain two 8-inch rifles mounted on 15-inch carriages altered for the purpose with funds allotted from the appropriation for "National Defense," act of March 9, 1898. It was expected that the land to be used for that purpose could be either purchased or leased. Inquiry developed the fact that no suitable terms could be made with the owners, and the site was transferred to an island where the Government owns a large reservation. This island is very exposed, and is accessible only by using lighters entering a small creek at high tide. It was thought at one time that terms which would permit the building of a wharf could be obtained. Bids were invited, but were all too high. A temporary wharf has been made in the small creek and material of all kinds taken to it and unloaded.

The site of the battery is a portion of an old fort built by the Confederates during the war. On June 30 a small house had been built for quarters for officers, a cement shed built at the site, a railroad graded from the wharf to the site, and all the material collected.

The gun platforms will be of concrete, and also the breast-height walls. The magazine will be of timber. The cover is ample. The whole will be finished during July, except the carriages, which are not ready to be placed.

Money statement.

April 27, 1898, amount allotted	$12,000.00
June 30, 1898, amount expended during fiscal year	1,191.09
July 1, 1898, balance unexpended	10,808.91
July 1, 1898, outstanding liabilities	5,000.00
July 1, 1898, balance available	5,808.91

DEFENSE OF GEORGETOWN, SOUTH CAROLINA.

On March 31, 1898, instructions were received from the Chief of Engineers to submit a project for temporary defense of Georgetown, S. C. On April 4 a report on the selection of sites was submitted,

together with papers from parties owning the land granting permission to erect the temporary fortifications. On April 6 the Chief of Engineers approved the selection of sites for two 5-inch B. L. siege guns and two 7-inch siege howitzers, and allotted $5,000 for construction from the appropriation for "National Defense," act of March 9, 1898.

Temporary batteries for two 7-inch B. L. howitzers were constructed, requiring the use of 6,000 sand bags and 1,500 cubic yards sand to fill in between walls. One magazine and one warehouse were erected for storage of ordnance supplies, emplacements for two guns were built, a well was driven, with force pump, and pipe connections completed to supply water to each of the two guns and magazines.

The old fort was rearranged, galleries excavated, parapet walls straightened, emplacements made for two guns, two magazines and storehouse built, force pump established and pipe drilled through the bed rock 50 feet below the surface, and pipe connections furnished for the water supply for both guns, warehouse, and magazines. Two 5-inch B. L. rifles were mounted and ammunition stored in magazines.

At another location two 7-inch B. L. howitzers were mounted and ammunition stored.

On May 16 orders were received from the Chief of Ordnance, by direction of the Secretary of War, to ship all ordnance and ordnance stores at Georgetown to Tampa, Fla. These guns have since been replaced by four light 12-pounder guns, which have been mounted.

Money statement.

April 6, 1898, amount allotted	$5,000.00
June 30, 1898, amount expended during fiscal year	3,277.97
July 1, 1898, balance unexpended	1,722.03
July 1, 1898, outstanding liabilities	1,000.00
July 1, 1898, balance available	722.03

Amount and date of all allotments for this work.

Date of act.	Date of allotment.	Amount.
March 9, 1898	Apr. 6, 1898	$5,000

4 L.

DEFENSES OF COAST OF GEORGIA AND CUMBERLAND SOUND, GEORGIA AND FLORIDA.

Officers in charge, Capt. Oberlin M. Carter, Corps of Engineers, until July 20, 1897; since that date Capt. Cassius E. Gillette, Corps of Engineers; assistants, Lieut. Henry S. Morgan, Corps of Engineers, since September 30, 1897, and Lieut. Charles S. Bromwell, Corps of Engineers, since April 13, 1898; Division Engineer, Brig. Gen. Peter C. Hains, U. S. Volunteers, Colonel, Corps of Engineers.

DEFENSES OF SAVANNAH.

Four emplacements for 8-inch rifles on disappearing carriages.—Plans and specifications for a wharf, and a railroad connecting the same with the emplacements, were completed by Captain Carter and approved by the Department during the last fiscal year. The contract for this

work was awarded on December 19, 1896, to P. Sanford Ross, of Jersey City, N. J. Work was commenced on February 22 and completed on May 31, 1897. For a detailed summary of the work done see page 700 of the Report of the Chief of Engineers for 1897. For an abstract of the bids received on the work see ibid., page 701.

Plans and specifications for the construction of four emplacements for 8-inch rifles, Buffington-Crozier disappearing carriages, were completed by Captain Carter, and approved by the Department during the last fiscal year. The contract for the work was awarded November 30, 1896, to the Venable Construction Company of Atlanta, Ga., and work was commenced by them on February 10, 1897. For an abstract of the bids received see page 702 of the Report of the Chief of Engineers for 1897. The work done up to the end of the last fiscal year consisted in the erection of a house for the use of the Government employees, in clearing and grubbing the site, in putting up the working plant, and in excavating 2,864 cubic yards of material.

Work on the emplacements was continued during the fiscal year under the above-mentioned contract, and extensions of the same granted from December 31, 1897, to June 15, 1898.

The parapet and magazines are built of natural-cement concrete; foundations, gun platforms, floors, and all 2-foot walls are built of Portland concrete; exposed surfaces are finished with a 10-inch layer of Portland concrete, mixed very rich, and with fine broken stone. The gun platforms have been constructed much heavier than contemplated in the design; they extend down to the level of the floor of shot magazine.

The soil under foundation consists of sand containing some earthy matter, and ordinarily only slightly moist. The load per square foot in most places varies from 3,400 to 4,000 pounds, which latter figure is about the maximum. In a few places the pressure is about 3,000 pounds, and in one place (under gun platforms) it is only about 2,000. Planes of weakness have been provided to guard against destructive cleavage in case of unequal settlement. No appreciable settlement has so far taken place, and the planes of weakness have proven an annoying source of leaks in some cases.

The ceilings of magazines are supported by steel beams about two feet apart, and dimensioned so as to safely carry from one-third to the whole of the superimposed load of concrete, according to circumstances.

Air spaces, 4 inches wide and 2 feet back from the face of walls, were formed around magazines, but were subsequently filled with a waterproof material and broken stone. Ventilation pipes connecting with lamp closets were arranged in magazines and passages, and were capped outside with storm-proof hoods. Brass speaking tubes were laid between each two adjacent emplacements, and likewise from each emplacement to the relocating room; also from the latter to an observing station formed into the concrete between the two interior emplacements. Pipes were run through the walls at suitable places to be used for electric wires.

The gun platforms and all interior surfaces accessible to rain were drained by a system of 4-inch iron drainpipes leading straight from manhole to manhole, so as to readily admit of cleaning, and connecting with an outside 10-inch main drain running in the rear of the battery and parallel to the direction of its length. From this drain the water is carried by means of another 10-inch drain into a ditch. No provision has as yet been made to prevent very high storm tides, such as occurred

in 1881 and 1893, from entering the grounds and flooding the emplacements.

A roadway 12 feet wide was constructed in the rear of the battery and paved with granite blocks and curbstone of granite.

Trolley beams and trolleys, cranes, and ammunition lifts have been arranged in accordance with typical drawings. An artesian well has been bored, and the sand surface of parapet is being sodded to prevent drifting.

At the end of the fiscal year all contract work was completed, the four guns were mounted, and the work ready for service. A few minor details, such as mouthpieces for speaking tubes, and some sodding, yet remain to be done. An electric-lighting system has not been provided, as it is deemed best to arrange that for all batteries at once. A temporary lighting arrangement, with lanterns, has been provided, and will be installed. Should emergency arise to make electric lighting advisable, an engine is on hand and the equipment could be rapidly completed.

The following is a list of materials that have been used in the construction of this work:

Excavation	cubic yards	5,450
Fill	do	35,357
Bricks		28,228
Concrete of all kinds	cubic yards	17,400.6
Cut stone	do	48.421
Iron pipe	pounds	46,649.1
Earthen pipe, 4 inches and 10 inches	linear feet	2,049
Steel beams, including trolley beams	pounds	98,714
Bolts, plates, and nuts	do	23,144.98
Ladders and handrails	do	6,765
Trolleys	do	840
Cranes		8
Ammunition lifts	pairs	8
Lumber for doors	feet B. M.	3,407
Metal work for doors	pounds	6,634
Paving blocks, granite	square yards	1,056
Curbing, granite	linear feet	1,094.5
Brass speaking tubes	do	610
Insulating (waterproofing)	pounds	85,285
Broken stone	cubic yards	26.66
Rosin-sized paper	square yards	2,172.3
Yale-Weston triplex blocks		12

Money statement.

July 1, 1897, balance unexpended	$130,958.40
Amount allotted during fiscal year	23,950.00
	154,908.40
June 30, 1898, amount expended during fiscal year	144,309.45
July 1, 1898, balance unexpended	10,598.95
July 1, 1898, outstanding liabilities	15,342.56
July 1, 1898, balance available	* —4,743.61

Emplacement for 12-inch B. L. rifles.—Preliminary drawings for detached emplacements for 12-inch B. L. rifles mounted on nondisappearing carriages were made. For the first one a working plant has been installed, the site for the gun platform excavated, and the platform built up to the height of the bottom of the anchor bolts for base ring.

* Covered by an allotment made after the close of the fiscal year.

For a second emplacement the installation of the working plant is about two-thirds completed, the site of the gun platform has been graded, the false works prepared, and the bins filled with stone. Railroad tracks and switches required for hauling material have been placed. Four telephone booths have been built at points selected by the artillery commander.

Money statement.

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

June 30, 1896, amount allotted during fiscal year	$40,000.00
June 30, 1898, amount expended during fiscal year	11,393.00
July 1, 1898, balance unexpended	28,607.00
July 1, 1898, outstanding liabilities	10,669.69
July 1, 1898, balance available	17,937.31

Rapid-fire gun emplacements.—Upon receipt of orders to build emplacements for 4.72-inch R. F. guns, work was begun at once. Lumber, tools, and cement were purchased and some excavation was made. Upon receipt of notice that the guns could not be procured, the work was stopped. The lumber was used in the 6-inch R. F. battery. The tools were transferred to the defenses of Wassaw Sound, and the cement (500 barrels), which had not been paid for, was transferred to the contractor for use in the 8-inch gun emplacements.

Money statement.

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

June 30, 1898, amount allotted during fiscal year	$180.71
June 30, 1898, amount expended during fiscal year	180.71

Emplacement for 6-inch R. F. gun.—At the end of the fiscal year the emplacement was practically completed. The concrete work and the sand fill were completed and the platform was ready for gun and carriage. A magazine and bombproof, both covered with steel roof beams, had been built. Portland cement, river sand, small gravel, and broken stone were used in the gun platform and small walls. Beach sand was used in the other masses of concrete.

The work remaining to be done consisted in the doors of magazine and bombproof, the wooden walk from loading platform to observation station, the sodding of the parapet, and the mounting of gun and carriage.

Money statement.

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

June 30, 1898, amount allotted during fiscal year	$9,000.00
June 30, 1898, amount expended during fiscal year	12,197.04
July 1, 1898, balance unexpended	—3,197.04
July 1, 1898, outstanding liabilities	1,478.33
July 1, 1898, balance available	* —4,675.37

Platform for 8-inch rifle.—A temporary platform for an 8-inch breech-loading rifle was built of concrete in one of the old forts, and the gun and carriage were mounted on it. With the exception of the elevating arc, which was not sent, the gun is ready for service.

* Covered by an allotment made after the close of the fiscal year.

Money statement.

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

June 30, 1898, amount allotted during fiscal year	$2,800.00
June 30, 1898, amount expended during fiscal year	2,730.21
July 1, 1898, balance unexpended	69.79

Overhauling 15-inch gun and repairing platform.—Two 15-inch guns, in the same fort, and their carriages were lifted out of the emplacements. Their foundations consisted of concrete up to within about 1 foot of the traverse circles; radial timbers above that. These timbers were rotten and wholly unserviceable. They were taken out and replaced with a solid concrete fill. The guns are now ready for service.

Money statement.

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

June 30, 1898, amount allotted during fiscal year	$1,950.00
June 30, 1898, amount expended during fiscal year	2,263.12
July 1, 1898, balance unexpended	* —313.12

Cable tank.—The inverted arches below two adjacent casemates of the same fort were cleaned out and converted into tanks by a partial filling with Portland cement concrete and plastering with the same material. The work was done by hired labor.

Money statement.

June 30, 1898, amount allotted during fiscal year	$200.00
June 30, 1898, amount expended during fiscal year	1.86
July 1, 1898, balance unexpended	198.14
July 1, 1898, outstanding liabilities	336.28
July 1, 1898, balance available	* —138.14

Rapid-fire gun emplacements at Wassaw Sound, Georgia.—The battery is modeled on the design for 5-inch R. F. guns shown on Mimeograph No. 16, Engineer Department, the principal modification consisting in the single central magazine for the two guns. Owing to the necessity for haste no drawings for it were prepared, the work being simply laid out on the ground. Lieutenant Morgan, Corps of Engineers, has had local charge of the work. At the end of the fiscal year the guns had been mounted, and the battery was complete and ready for service.

It was constructed of Portland concrete, with a sand parapet in front, the foot of the exterior slope of which was partially protected with trunks of palmetto trees. About 4 inches of oyster shells were placed to hold the exterior slope. The superior slope was covered with grass sod obtained near the works. Steel roof beams could not be obtained in time, so steel railroad rails were used. No waterproof material was used to protect the magazine, but it is dry and in good condition.

There are no means of communication with the battery except by boats landing on the beach. A small walk was built, against which a small boat can land at high water. Signals can be exchanged with Tybee by using the light-house.

* Covered by an allotment made after the close of the fiscal year.

A 4-inch artesian well affords an abundant supply of good water. Three temporary buildings erected in the construction of the battery are available for kitchens, storehouses, and possibly for temporary quarters for a small garrison.

Money statement.

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

June 30, 1898, amount allotted during fiscal year	$11,000.00
June 30, 1898, amount expended during fiscal year	9,967.25
July 1, 1898, balance unexpended	1,032.75
July 1, 1898, outstanding liabilities	169.85
July 1, 1898, balance available	862.90

TEMPORARY DEFENSES OF DARIEN, GA.

For the defense of Darien the following temporary batteries were constructed:

1. One battery at the south end of Sapelo Island, commanding the approach to Darien through Doboy Sound and also the mouth of South River. A magazine has been constructed of heavy timber and covered with sand. Both parapet and magazine are covered with grass sods on the outside to prevent the blowing of the sand. A small driven well was sunk and supplied with a pump.

2. One battery at the north end of Blackbeard Island, commanding the approach to Darien through Sapelo Sound and also the mouth of South Newport River. A magazine had been constructed with timber and covered with sand.

Money statement.

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

June 30, 1898, amount allotted during fiscal year	$10,000.00
June 30, 1898, amount expended during fiscal year	7,397.80
July 1, 1898, balance unexpended	2,602.20
July 1, 1898, outstanding liabilities	450.92
July 1, 1898, balance available	2,151.28

TEMPORARY DEFENSES OF BRUNSWICK, GA.

For the defense of Brunswick the following temporary batteries were constructed:

1. One battery at the south end of St. Simons Island, commanding the approach to Brunswick through St. Simons Sound and also the inside route from Savannah, Ga., to Fernandina, Fla. A magazine has been constructed of plank and covered with sand.

2. One battery on St. Simons Island, east of the one described above. A magazine has been constructed of plank and covered with sand.

3. One battery at the north end of Jekyl Island.

4. One battery at the south end of Jekyl Island. A magazine has been constructed of plank and covered with sand.

Money statement.

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

June 30, 1898, amount allotted during fiscal year	$12,000.00
June 30, 1898, amount expended during fiscal year	8,601.23
July 1, 1898, balance unexpended	3,398.77
July 1, 1898, outstanding liabilities	689.48
July 1, 1898, balance available	2,709.29

DEFENSES OF CUMBERLAND SOUND.

At the old fort a temporary parapet of sand bags was constructed in front of two 15-inch Rodman guns on the eastern face, and a sand fill made on the outside of it, extending to the 5-foot wall. A platform was put up back of the guns and a bracket erected to act as a crane for raising projectiles.

A quantity of ammunition was received, and thirty 15-inch shells were shipped to another work.

Money statement.

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

June 30, 1898, amount allotted during fiscal year	$1,200.00
June 30, 1898, amount expended during fiscal year	468.06
July 1, 1898, balance unexpended	731.94
July 1, 1898, outstanding liabilities	578.42
July 1, 1898, balance available	153.52

Emplacement for 8-inch B. L. rifle.—A survey was made of the site and plans of an emplacement were drawn in which an 8-inch B. L. rifle was to be mounted on a modified 15-inch S. B. carriage. The old pintle stone was removed and a retaining wall of brick concrete built back of the emplacement. About 1,500 cubic yards of sand was placed in the parapet. The work has been delayed by the nonarrival of broken stone ordered and was not completed at the end of the fiscal year.

Money statement.

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

June 30, 1898, amount allotted during fiscal year	$4,500.00
June 30, 1898, amount expended during fiscal year	41.94
July 1, 1898, balance unexpended	4,458.06
July 1, 1898, outstanding liabilities	3,319.39
July 1, 1898, balance available	1,138.67

Temporary batteries.—The moat of the old work was filled in sufficiently to remove all stagnant water and to make its general level high enough to prevent any water standing in pools during wet weather. A sand causeway was built across the moat at the sally port. The cisterns back of the barracks were baled out and filled with sand. The roof of the barracks was repaired. An artesian well was sunk to a depth of 386 feet. The flow is from 8 to 9 gallons per minute of fine water, rather strong in sulphur. It rises about 7 feet above the level of the parade.

Money statement.

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

June 30, 1898, amount allotted during fiscal year	$1,600.00
June 30, 1898, amount expended during fiscal year	1,242.43
July 1, 1898, balance unexpended	357.57
July 1, 1898, outstanding liabilities	28.10
July 1, 1898, balance available	329.47

Temporary batteries at Fernandina, Fla.—To prevent small vessels reaching Fernandina by the inside route through Cumberland Sound, a battery was built at the north end of Little Cumberland Island. A magazine has been constructed of planks and covered with sand.

Money statement.

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

June 30, 1898, amount allotted during fiscal year	$2,000.00
June 30, 1898, amount expended during fiscal year	576.05
July 1, 1898, balance unexpended	1,423.95
July 1, 1898, outstanding liabilities	4.50
July 1, 1898, balance available	1,419.45

Torpedo defense of Savannah Harbor.—It is proposed to plant mines and to operate them from a temporary operating room of timber, concealed in the sand dunes and shrubbery. A search-light outfit is to be operated also.

This casemate is located in a slight depression in the sand hills, and when completed will present nothing to disclose its locality. Its inside dimensions are 12 by 16 feet, 7 feet high, with a well in the center, from which the cable will lead out through the sand hills to the beach. It is constructed of 4 by 6 inch yellow pine framing, thoroughly braced, the roof being strengthened by simple King trusses over the joists. This framing is covered with 2-inch planks, which are covered on the outside with tar paper to render the casemate dry. Steps lead down to the entrance, which is 3 feet wide. The casemate will be ventilated by five 4-inch pipes, three of which are arranged for the suspension of lamps. At the end of the fiscal year the work was about half completed. It will be entirely completed and ready for service by the 8th of July.

Money statement.

TORPEDOES FOR HARBOR DEFENSE, JANUARY 1, 1899.

June 14, 1898, amount allotted	$2,500.00
July 1, 1898, balance unexpended	2,500.00
July 1, 1898, outstanding liabilities	187.20
July 1, 1898, balance available	2,312.80

By Department letter of March 18, 1898, an allotment of $1,000 was made for the purchase of explosives for use in the torpedo defense of Savannah, Ga.; two additional allotments, amounting to $3,500, were made by the Chief of Engineers, all from the appropriation for "National Defense," act of March 9, 1898.

The casemate apparatus was received on the 5th of April. Lieutenant Bromwell reported for duty on the 13th of April and was placed in charge of the torpedo defense of Savannah. A sergeant and six privates from the engineer battalion at Willetts Point arrived on the 8th of April.

A trench for the cable was dug from the casemate to the water's edge, the operating apparatus was installed in the mining casemate, and mines were put in place. Two mines were afterwards cut out on account of their buoys having been struck by propeller blades, one being cut in two and the other being made leaky. The rest of the mines were in good condition at the end of the fiscal year.

Money statement.

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

June 30, 1898, amount allotted during fiscal year	$4,500.00
June 30, 1898, amount expended during fiscal year	3,491.10
July 1, 1898, balance unexpended	1,008.90
July 1, 1898, outstanding liabilities	1,140.92
July 1, 1898, balance available	*—132.02

Torpedo defense of Cumberland Sound, Georgia and Florida.—Dynamite was purchased and received, and a group of mines planted.

Money statement.

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

June 30, 1898, amount allotted during fiscal year	$1,500.00
June 30, 1898, amount expended during fiscal year	326.25
July 1, 1898, balance unexpended	1,173.75
July 1, 1898, outstanding liabilities	606.15
July 1, 1898, balance available	567.60

Preservation and repair of fortifications, Cumberland Sound.—Under a contract with O. S. Oakes, of Fernandina, Fla., the leaky roof of the storehouse was repaired at a cost of $25.

An allotment of $500 was made by telegram of the Chief of Engineers on April 15, 1898, for placing the armament in serviceable condition. The 15-inch Rodman guns were cleaned up and sights put on them. Elevating scales were put on the guns facing east and their vents cleaned; the vents of two guns were found to be spiked, and with the available tools no new vents could be bored.

Two doors were taken from the old guardhouse dungeons and were placed as doors to temporary magazines. An opening 2½ feet wide and 7 feet deep was cut through the 5-foot wall of the northwest front to make a passage to sinks, to be built by the Quartermaster's Department. A room in the hospital building, in which asphaltum used to be stored, and the floor of which was covered about 6 inches deep from leakage of barrels, was cleaned out and the asphaltum gathered for future use.

A footpath 1,000 feet long and 2 to 3 feet above the marsh was built across the marsh at Old Fernandina.

* Covered by an allotment made after the close of the fiscal year.

Money statement.

April 15, 1898, amount allotted	$500.00
June 30, 1898, amount expended during fiscal year	111.15
July 1, 1898, balance unexpended	388.85
July 1, 1898, outstanding liabilities	53.69
July 1, 1898, balance available	335.16

Preservation and repair of fortifications, Savannah.—An allotment of $500 was made to improve the sanitary condition of one of the old forts. A ditch 6 feet wide and 3 feet deep was dug around the fort in the old moat, which latter had become filled with a deposit of soft mud, preventing all tidal flow. The ditch dug in this is connected with the south channel, and keeps the moat well drained.

The grass and brush in the fort have been cut and the place generally cleaned up, and proper earth closets built to replace old ones, which were in an unsanitary condition.

Money statement.

June 1, 1898, amount allotted	$500.00
June 30, 1898, amount expended during fiscal year	125.12
July 1, 1898, balance unexpended	374.88
July 1, 1898, outstanding liabilities	289.68
July 1, 1898, balance available	85.20

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4 M.

DEFENSES OF EAST AND WEST COASTS OF FLORIDA.

Officer in charge, Lieut. Col. William H. H. Benyaurd, Corps of Engineers; assistants, Capt. Robert P. Johnston, U. S. Volunteers, Lieutenant, Corps of Engineers, until February 1, 1898, and since June 19, 1898, and Maj. William W. Harts, U. S. Volunteers, Lieutenant, Corps of Engineers, since April 28, 1898.

Fort Marion, St. Augustine, Fla.—For a brief historical sketch of this work, which was built during the Spanish possession and finished in 1756, attention is invited to annual report of engineer in charge for 1889. It is not available for defense, but is worthy of preservation as an object of historical interest.

There had been mounted there for target practice of the artillery troops at St. Francis Barracks one 8-inch converted rifle, but this was dismounted on April 30, 1898, and moved to a temporary battery.

No funds were available for preservation and repair of this work during the fiscal year.

Temporary battery at St. Johns River, Florida.—In pursuance of telegraphic instructions of the Chief of Engineers, dated April 4, 1898, a site for a temporary battery to mount 5-inch breech-loading siege rifles and 7-inch breech-loading siege howitzers was selected on the St. Johns River, Florida. The land being owned by private individuals, consent for its occupancy for fortification purposes was obtained. Work on the construction of the battery was commenced on April 11. It was built of 10-inch by 10-inch timber in revetment and magazine walls with sand embankment. Two magazines in traverses were provided.

The work was so near completion that in the middle of May, upon the arrival of the ordnance material, the guns and howitzers were immediately mounted in position in the battery.

Funds for the construction of this battery were provided by allotment of $13,160 from the appropriation for "National Defense" made by the act of March 9, 1898.

Money statement.

Amount allotted	$13,160.00
June 30, 1898, amount expended during fiscal year	9,892.73
July 1, 1898, balance unexpended	3,267.27
July 1, 1898, outstanding liabilities	3,247.41
July 1, 1898, balance available	19.86

Temporary battery at St. Augustine, Fla.—Under instructions of the Chief of Engineers a site for a temporary battery was selected on April 9, 1898, and a project submitted, which was approved April 14, 1898.

The battery was designed to be built with timber revetment walls and sand embankment, with two magazines in traverses, also built of timber and covered with sand.

Funds for the construction of this battery were provided by allotment of $12,460 from the appropriation for "National Defense," made by the act of March 9, 1898.

Money statement.

Amount allotted	$12,460.00
June 30, 1898, amount expended during fiscal year	10,573.10
July 1, 1898, balance unexpended	1,886.90
July 1, 1898, outstanding liabilities	1,710.69
July 1, 1898, balance available	176.21

Temporary battery at Miama, Fla.—In pursuance of telegraphic instructions received from the Chief of Engineers on April 2, 1898, an examination of the country in the immediate vicinity of Miami was made on April 4 and 5, and a site for a temporary battery was selected, and consent of the owner for its occupancy was obtained.

The formation around Miami being of coral rock, with little or no earth or sand covering, the necessary sand for embankment had to be obtained by dredging from Biscayne Bay. One of the dredges of the Florida East Coast Railway Company, in use in that locality, was obtained for this work, and a wooden bulkhead was built on the rocky face of the site to retain the dredged material.

The work of clearing the site and the construction of the battery was commenced on April 13, and by the 12th of May the battery was practically completed.

Funds for the construction of this battery were provided by allotment of $12,640 from the appropriation for "National Defense" made by the act of March 9, 1898.

Money statement.

Amount allotted	$12,640.00
June 30, 1898, amount expended during fiscal year	10,027.56
July 1, 1898, balance unexpended	2,612.44
July 1, 1898, outstanding liabilities	2,612.44

Temporary batteries at Tampa Bay, Florida.—Instructions to select site and commence construction of temporary batteries were received on April 15 and 18, 1898, respectively. The sites selected were on lands belonging to the United States.

Owing to remoteness from points of communication with the outside world, many difficulties to the successful prosecution of the work had to be provided for. This condition was more difficult to contend with on account of the congestion arising through the concentration of troops and supplies at Tampa and the embarkation of the army expedition to Cuba from that point.

On April 26 work was commenced on the batteries. They were constructed of timber and sand, and were both completed by June 30.

The guns and howitzers, which had arrived at Tampa in May, were transferred to the ordnance depot, but on May 31 were turned back to the Engineer Department, and transported to the batteries. They were mounted in position in the batteries on June 1.

Funds for the construction of these batteries were provided by allotment of $14,900 from the appropriation for "National Defense" made by the act of March 9, 1898.

Money statement.

Amount allotted	$14,900.00
June 30, 1898, amount expended during fiscal year	7,930.40
July 1, 1898, balance unexpended	6,969.60
July 1, 1898, outstanding liabilities	6,377.32
July 1, 1898, balance available	592.28

Emplacements for two 8-inch B. L. rifles at St. Johns River, Florida.—Under date of April 27, 1898, the construction of two emplacements for 8-inch breech-loading rifles, to be mounted on strengthened 15-inch barbette carriages, was ordered. Funds for this work were provided by allotment of $29,000 from the appropriation for "National Defense," made by the act of March 9, 1898. Site was selected on land belonging to private individuals, whose consent to its occupancy by the Government had previously been obtained. Immediate steps were taken for the commencement of the work of construction. Site was cleared, railroad track extended from the wharf built preliminary to the construction of a temporary battery on a contiguous site, a well driven to obtain the necessary water supply, and other general preparations made for carrying the work to completion.

Plans of the battery were submitted on June 14, and were approved on June 17, 1898.

By the end of the fiscal year the excavation for the battery was completed, foundations for the platforms were prepared, sand and cement for concrete on hand in sufficient quantity to proceed with the construction, and all arrangements were made for the concrete work. This work would have been under way except for unavoidable delay in the arrival of broken stone and part of the iron work.

Money statement.

Amount allotted	$29,000.00
June 30, 1898, amount expended during fiscal year	2,194.31
July 1, 1898, balance unexpended	26,805.69
July 1, 1898, outstanding liabilities	5,945.08
July 1, 1898, balance available	20,860.61

Emplacements for two 6-inch R. F. guns at Tampa Bay, Florida.—Under date of April 25, 1898, the construction of two emplacements for 6-inch rapid-fire guns on pedestal mounts at Tampa Bay, was ordered. Funds for this purpose were provided by allotment of $29,600 from the appropriation for "National Defense," act of March 9, 1898.

A site for the battery was selected on land reserved for military purposes.

Plans were submitted on June 4 and were approved on June 7, 1898.

In designing this battery the type plans for the 5-inch rapid-fire gun were generally followed, and adapted to the mounting of the 6-inch guns. The magazine capacity and the thickness of cover was materially increased over that provided in the plan for the 5-inch guns.

Authority was given for the commencement of construction in advance of the approval of plans, and accordingly steps were taken as soon as possible to carry this into effect. But, other than the making of general preparations for construction work, the purchase and procurement of material, nothing had been accomplished at the close of the fiscal year.

As in the case of the other works ordered at Tampa Bay, much delay was occasioned by reason of the great congestion of railroad and shipping facilities at Tampa, resulting from the concentration of troops and supplies, and the embarkation of the expedition to Cuba from this point.

Money statement.

Amount allotted	$29,600.00
June 30, 1898, amount expended during fiscal year	341.53
July 1, 1898, balance unexpended	29,258.47
July 1, 1898, outstanding liabilities	3,319.99
July 1, 1898, balance available	25,938.48

Emplacements for two 8-inch B. L. rifles at Tampa Bay, Florida.—Under date of April 27, 1898, the construction of two emplacements for 8-inch breech-loading rifles, to be mounted on strengthened 15-inch barbette carriages, was ordered. Funds for this work were provided by allotment of $29,500 from the appropriation for "National Defense," act of March 9, 1898. A site was selected on land owned by the United States, and immediate steps were taken for the commencement of the work of construction.

Cement, iron work, and pintle stones were ordered, and arrangements made to secure a supply of sand and broken stone. Temporary buildings for shelter of the laborers and others that might be employed on the work, and for storage of cement and other materials, were constructed.

Plans of the battery were submitted on June 14, and were approved on June 17, 1898.

At the close of the year no work of actual construction of the battery had been done, by reason of the nonarrival of material. The great congestion of railroad facilities at Tampa and the difficulty of getting tugs and barges there, resulting from the concentration of troops and army supplies, and the embarkation of the expedition to Cuba from this point also made the rapid prosecution of the work on the batteries impossible. It was in some cases impossible to get material for two weeks after its arrival at Tampa.

Money statement.

Amount allotted	$29,500.00
June 30, 1898, amount expended during fiscal year	408.35
July 1, 1898, balance unexpended	29,091.65
July 1, 1898, outstanding liabilities	3,874.28
July 1, 1898, balance available	25,217.37

Mine defense of St. Johns River, Florida.—Under date of April 4, 1898, directions were received to cooperate with the citizens of Jacksonville, Fla., in furnishing and placing in position by them of a system of temporary mines.

On April 15 it transpired that the committee representing the Jacksonville people expected the Government to furnish and place the mines. Upon reporting this fact, mines with adjuncts were ordered sent from Willets Point and Washington; cable and the necessary dynamite were purchased; a temporary casemate was built; a number of groups of mines were laid in the St. Johns River, and other groups were held in readiness to be placed on short notice to close the channel.

Funds for installing and maintaining these mines were provided by allotment of $8,000 from appropriation for "Torpedoes for Harbor Defense, January 1, 1899."

Money statement.

Amount allotted	$8,000.00
June 30, 1898, amount expended during fiscal year	490.70
July 1, 1898, balance unexpended	7,509.30
July 1, 1898, outstanding liabilities	4,656.99
July 1, 1898, balance available	2,852.31

Mine defense of Tampa Bay, Florida.—Under date of May 10, 1898, instructions were given by the Chief of Engineers to make the necessary arrangements for planting mines for the defense of Tampa Bay, and material was ordered shipped.

The sum of $16,300 was allotted from the appropriation for "Torpedoes for Harbor Defense, January 1, 1899," for purchase of explosives, construction of casemate, laying mines, and patrolling mine fields.

At the close of the fiscal year no mines had been laid; all operations to that date consisted of the accumulation and transporting of material. There was not sufficient material on hand to inaugurate the mine system.

Money statement.

Amount allotted	$16,300.00
July 1, 1898, balance unexpended	16,300.00
July 1, 1898, outstanding liabilities	1,131.51
July 1, 1898, balance available	15,168.49

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4 N.

DEFENSES OF KEY WEST.

Officers in charge, Lieut. Col. William H. H. Benyaurd, Corps of Engineers, until February 1, 1898, and Capt. Charles H. McKinstry, Corps of Engineers, since February 1, 1898; assistant, Lieut. Robert P.

Johnston, Corps of Engineers, until June 19, 1898; Division Engineer, Brig. Gen. Peter C. Hains, U. S. Volunteers, Colonel, Corps of Engineers, since February 1, 1898.

Gun and mortar batteries.—The gun battery (south battery) contains emplacements for four 10-inch guns on disappearing carriages, model 1896, and two 8-inch guns on disappearing carriages, model 1894; the mortar battery contains emplacements for eight 12-inch rifled mortars.

These works are being built by contract under the provisions of act of June 6, 1896.

The work was first advertised October 24, 1896, and bids were opened November 24, 1896, all of which were rejected under instructions from the Chief of Engineers. The work was readvertised December 2, 1896, and new bids, opened December 28, 1896, were likewise rejected. A third time bids were invited, on January 30, resulting in the acceptance of the proposal of the Venable Construction Company, of Atlanta, Ga. Contract was entered into with this company on March 4, 1897, and approved March 27, 1897, for the construction of the two batteries, the work to be commenced by March 20, 1897, and completed by January 1, 1898. On September 8, 1897, the time for the completion of the contract was extended until May 15, 1898; on May 14, 1898, until June 7; on June 8 until September 7, 1898.

The cost of the contract work will be about $400,000, and this amount was allotted May 15, 1897, from the funds appropriated by the act of March 3, 1897. The cost of supervision, engineering, office, and miscellaneous expenses was estimated at $12,225, and for this purpose the sum of $1,000 was allotted on December 14, 1896, and $11,225 on March 18, 1897. The cost of supervision and inspection having been increased by the failure of the contractors to complete the work by the time originally specified, $6,000, in addition to the $12,225 mentioned above, was allotted June 25, 1898.

An inventory of the plant used by the contractors will be found in the Annual Report for 1897, Part I, page 704.

The concrete work at the gun battery is practically completed. All iron work is completed except ammunition hoists in five emplacements. A few doors remain to be placed. The sand fill in front of concrete parapet has not yet been begun; about 70,000 yards are to be placed.

Guns and carriages have been mounted in emplacements 1, 2, 3, 4, and 5. The carriage for the fourth 10-inch gun has not yet been received. The gun is on hand.

About 800 cubic yards concrete remain to be placed at the mortar battery, viz, in inclined retaining walls about the pits, in vertical retaining walls for sand fill at entrance to pits, and in pavements. About 1,900 cubic yards of sand fill have been placed; about 78,000 yards remain to be placed.

Six carriages have been mounted complete; the other two, and the eight mortars have not yet been received.

The items of work accepted and paid for to June 30, 1898, are tabulated below:

GUN BATTERY.

Sand excavation	cubic yards	2,116
Sand fill	do	4,509
Concrete No. 1	do	23,723.8
Concrete No. 2	do	1,801.6
Concrete No. 3	do	1,478.7
Large stone	tons	8,883.6
Beams, plates, etc	pounds	80,571.2
Anchor bolts	do	16,458

Doors		33
Brass fittings for doors	pounds	4,935.5
Vitrified pipe, 6-inch	feet	128
Trolley beams, bolts, hangers, etc	pounds	11,049
Asphalt covering	square yards	1,611.9
Brick		41,064
Ladders	pounds	1,315
Speaking tubes	feet	619.2
Stairs	pounds	6,385
Cranes		12
Ammunition hoists		2
Manhole covers		6
Galvanized sheet iron	pounds	220
Iron-pipe railing	feet	1,220.8
Iron-pipe railing posts	do	346

MORTAR BATTERY.

Sand excavation	cubic yards	279
Coral rock excavation	do	460.9
Sand fill	do	2,345.6
Concrete No. 1	do	6,086
Concrete No. 2	do	654.9
Concrete No. 3	do	179.3
Cut stone	do	113.69
Beams, plates, etc	pounds	50,825.8
Anchor bolts	do	29,033.9
Brass fittings for doors	do	110
Vitrified pipe, 6-inch	feet	47
Trolley beams, bolt hangers, etc	pounds	8,693
Asphalt covering	square yards	844.1
Brick		7,552
Speaking tubes	feet	19.8

Money statements.

FOR CONTRACT WORK.

July 1, 1897, balance unexpended		$400,000.00
June 30, 1898, amount expended during fiscal year		272,040.08
July 1, 1898, balance unexpended		127,959.92
July 1, 1898, outstanding liabilities	$8,909.48	
July 1, 1898, amount covered by uncompleted contracts	119,050.44	
		127,959.92

FOR EXPENSES OF OFFICE, ENGINEERING, AND SUPERVISION.

July 1, 1897, balance unexpended	$9,467.97
June 25, 1898, allotted	6,000.00
	15,467.97
June 30, 1898, amount expended during fiscal year	14,614.01
July 1, 1898, balance unexpended	853.96
July 1, 1899, outstanding liabilities	767.81
July 1, 1898, balance available	86.15

Landing, transporting, and mounting guns and carriages.—The guns and carriages for the gun and mortar batteries are to be received on the south breakwater, and thence transported on cars to the different emplacements. One thousand seven hundred dollars was allotted December 8, 1897; $4,100 March 5, 1898, and $3,500 June 5, 1898.

Three 10-inch carriages, two 8-inch carriages, and six 12-inch mortar carriages have been received and mounted.

Four 10-inch and two 8-inch guns have been received.

Three 10-inch and two 8-inch guns have been mounted.

The fourth 10-inch gun is on the breakwater, where it will be left until its carriage has been received.

Money statement.

December 8, 1897, allotted	$1,700.00
March 5, 1898, allotted	4,100.00
June 5, 1898, allotted	3,500.00
	9,300.00
June 30, 1898, amount expended during fiscal year	6,363.57
July 1, 1898, balance unexpended	2,936.43
July 1, 1898, outstanding liabilities	2,215.36
July 1, 1898, balance available	721.07

Mining casemate and cable gallery.—The work contemplated was the construction of mining casemate and the necessary cable gallery similar to the typical form. Estimated cost was $10,000, and this amount was allotted November 13, 1896.

For description of structure, difficulties met with in foundation, etc., see Annual Report for 1897, pages 705 and 706. The work was completed in December, 1897, except for a small amount of fill and sodding. Funds are exhausted.

Money statement.

July 1, 1897, balance unexpended	$4,801.16
June 30, 1898, amount expended during fiscal year	4,762.73
July 1, 1898, balance unexpended	38.43
July 1, 1898, outstanding liabilities	28.40
July 1, 1898, balance available	10.03

Purchase of sites.—The sites referred to are needed for modern defensive works contemplated by the approved project for the defense of Key West. The first is a rectangular piece of ground on which Martello Tower No. 2 is situated. An agreement was reached with the representative of the Livermore estate for the purchase of this site for $4,600. This amount was allotted January 26, 1897, from the fund appropriated by the act of June 6, 1896. One hundred dollars for incidental expenses was allotted from the same appropriation April 30, 1897. The land has been purchased.

The second tract of land is a rectangular tract on which Martello Tower No. 1 is located. No satisfactory agreement could be reached with the owners of this site, the price demanded being excessive. Accordingly, proceedings for the condemnation of the land were instituted by theUnited States district attorney. The land was appraised by viewers appointed by the United States circuit court, southern district of Florida, at $19,750. March 22, 1898, $19,800 was allotted for the purchase of this land and the payment of incidental expenses. Payment was made May 31, 1898.

Money statement.

July 1, 1897, balance unexpended	$4,692.95
March 22, 1898, allotted	19,800.00
	24,492.95
June 30, 1898, amount expended during fiscal year	24,364.74
July 1, 1898, balance unexpended and available	128.21

Preservation and repair.—At the beginning of the year the available balance was $3,726.98. On March 24, 1898, $300 was allotted for care of torpedo material; on March 25, 1898, $2,000 for rebuilding of two temporary platforms for 15-inch smooth-bore guns, and on March 28,

1898, $3,650 was allotted for constructing platforms for three 8-inch converted rifles at the north battery.

Repairs were made to the engineer office and other buildings and to the fences, the grounds were cared for, and a large amount of property stored at the fort was kept in good condition.

The rebuilding of the bridge leading from Key West to the outwork of the fort was completed.

The two unserviceable platforms for 15-inch guns were torn out and replaced by temporary platforms of timber and concrete, and the carriages and guns were mounted.

The two unserviceable platforms for 15-inch smooth-bore guns in the north battery were torn out and the guns, still mounted on the carriages, moved to the rear. Three platforms for 8-inch converted rifles were constructed on the site of the old platforms. These platforms are of concrete with granite pintle blocks. The carriages and guns were mounted.

Money statement.

July 1, 1897, balance unexpended	$3,726.98
March 24, 1898, allotted	300.00
March 25, 1898, allotted	2,000.00
March 26, 1898, allotted	3,650.00
	9,676.98
June 30, 1898, amount expended during fiscal year	8,759.49
July 1, 1898, balance unexpended	917,49
July 1, 1898, outstanding liabilities	182.52
July 1, 1898, balance available	734.97

Emplacements for two 12-inch breech-loading rifles.—Under date of April 25 directions were received to construct two emplacements for 12-inch breech-loading rifles on barbette nondisappearing carriages. Forty thousand dollars was allotted April 25 from the appropriation for "National Defense," act of March 9, 1898.

Investigations have been made to determine the character of the foundation of the old fort. A portion of the plant required has been ordered, viz, steam pump, drill complete, mixer, stone crusher, and hoisting engine. The work of tearing down that part of the old fort which is in the way of the new construction has been begun.

Money statement.

April 25, 1898, allotted	$40,000.00
June 30, 1898, amount expended during fiscal year	675.35
July 1, 1898, balance unexpended	39,324.65
July 1, 1898, outstanding liabilities	8,889.25
July 1, 1898, balance available	30,435.40

Two rapid-fire gun emplacements, Key West, Fla.—Under date of March 19, 1898, directions were received to prepare to mount at the earliest practicable date two 4.7-inch rapid-fire guns. Six thousand dollars was allotted April 6, 1898, and $4,000 April 13, 1898, all from the appropriation for "National Defense," act of March 9, 1898.

As it was found impossible to secure at once the necessary sand and broken stone for permanent emplacements, two temporary platforms were built, and the guns mounted as soon as they arrived. A small amount of materials, viz, Portland cement, broken brick, and coral sand, has been collected at the site of the work. One gun-base form has been erected, and plant for placing concrete, viz, overhead trolley with engine, has been set up.

Money statement.

April 6, 1898, allotted	$6,000.00
April 13, 1898, allotted	4,000.00
	10,000.00
June 30, 1898, amount expended during fiscal year	2,564.96
July 1, 1898, balance unexpended	7,435.04
July 1, 1898, outstanding liabilities	109.92
July 1, 1898, balance available	7,325.12

Planting torpedoes, Key West, Fla.—On June 20, 1898, $5,000 was allotted, and on June 30, 1898, $8,000; both amounts from the appropriation for "Torpedoes for Harbor Defense, January 1, 1899," act of May 4, 1898. These funds were allotted for the purpose of continuing the submarine defense of this harbor begun under appropriation for "National Defense."

Details of work done will be found in the subjoined report for torpedo defense for Key West, "National Defense," act of March 9, 1898.

Money statement.

June 20, 1898, allotted	$5,000.00
June 30, 1898, allotted	8,000.00
July 1, 1898, balance unexpended	13,000.00
July 1, 1898, outstanding liabilities	3,923.90
July 1, 1898, balance available	9,076.10

Torpedo defense for Key West, Fla.—Two thousand dollars was allotted March 18, $2,000 April 22, and $5,000 May 27, 1898; all from appropriation for "National Defense," act of March 9, 1898.

Single and multiple cable, mines and plugs, buoys, and other materials have been received.

A 30-inch search light with boiler and generating set have been received and set up; the light is in operation nightly. The mine field has been patrolled.

Money statement.

March 18, 1898, allotted	$2,000.00
April 22, 1898, allotted	2,000.00
May 27, 1898, allotted	5,000.00
	9,000.00
June 30, 1898, amount expended during fiscal year	9,000.00

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4 O.

DEFENSES OF PENSACOLA, FLORIDA.

Officer in charge, Maj. Frederick A. Mahan, Corps of Engineers; assistant, Lieut. James P. Jervey, Corps of Engineers; Division Engineer, Brig. Gen. Peter C. Hains, U. S. Volunteers, Colonel, Corps of Engineers.

Battery for four 10-inch guns on disappearing carriages.—Details of this battery are given in the report of the Chief of Engineers for 1897. All the concrete for this battery was finished during the fiscal year 1897.

Work during the year 1898 was applied to installing the electric-light plant, ammunition conveyors, cranes, and hoists, to putting in the sewerage system, to covering the sand slopes with muck, and to mounting the guns.

Emplacements 1, 2, and 3 were transferred to the artillery arm of the service by authority of the Secretary of War dated February 24, 1898. The fourth emplacement was transferred by authority dated June 19, 1898, thus placing the entire battery in charge of its final custodians.

The cost of this work for the year is given in the following statement:

Cost of items.

Classification.	Labor.	Material.	Total.
Conveyors (750 feet)	$436.04	$2,326.00	$2,762.04
Cranes (14)	164.68	660.00	824.68
Hoist (2)	170.05	940.00	1,110.05
Sewerage system	.....	627.50	627.50
Muck on slopes	827.28	27.75	855.03
Mounting guns (4)	3,091.98	215.41	3,307.39
Setting traverse circles and base rings	1,088.35	2.25	1,090.60
Concrete aprons	368.85	450.00	818.85
Manholes	176.12	4.95	181.07
Superintendence	318.31	.....	318.31
Holidays	320.35	.....	320.35
Road rear of battery	446.41	.....	446.41
Water supply	.....	5.40	5.40
Railroad	.....	11.92	11.92
Fuel	.....	38.50	38.50
Tools and nonexpendable articles	.....	13.50	13.50
Boats and lighters	224.43	415.87	640.30
Mileage	.....	159.16	159.16
Advertising and printing	.....	54.83	54.83
General purposes	.....	23.60	23.60
Sundries	72.65	135.61	208.26
Operating mail boat	151.50	.....	151.50
Waterproofing	.....	700.00	700.00
Lighting plant	154.33	3,933.35	4,087.68
Subsistence	.....	60.63	60.63
Platforms	.....	263.52	263.52
Doors	.....	25.22	25.22
Total	8,011.33	11,094.97	19,106.30

Battery for eight 12-inch mortars.—The report of Lieutenant Jervey on the cost and methods of work of this battery is so interesting that the following extract from it is given.

EXTRACT FROM REPORT OF FIRST LIEUT. JAMES P. JERVEY, CORPS OF ENGINEERS.

Plans and estimates were submitted on May 21, 1897. These were disapproved. Revised plans and estimates were submitted on July 12, 1897, and approved August 6, 1898, the sum of $121,000 being allotted for the work.

Work on the railroad had been already started. This work was pushed as rapidly as possible, and on its completion the sand filling for the foundations of the battery and the erection of plant were begun.

The progress of the work was seriously delayed by the appearance of yellow fever in September. The bids received for the delivery of material were so high that all were rejected, except those for natural cement and the electric plant. New bids were asked. No Portland cement, which was required for the foundations, was received until the middle of February.

Concreting was started on February 18, and practically completed on May 31, during which time 9,700 yards of concrete were laid. The actual number of days of work was 70. This gave an average of 138.5 cubic yards per day.

Construction details: The mortar platforms start at reference (4.0) and on wet sand. This sand seemed unstable and to have no bearing power. A retaining wall was built around the pits to prevent the sand spreading laterally; it seems to have been successful. This was the only difficulty encountered.

Plant: The raw materials were stored in bins under which ran a double track. The proper charges, dumped into iron concrete cars, were hauled up an incline over

the mixers by a wire rope haulage plant which was improvised on the work. Two cubical mixers were used. The concrete was dumped from the mixers into tubs resting on flat cars and hauled by mules under a traveling Lidgerwood cableway. The maximum day's work was 258 charges.

Waterproofing: In waterproofing the magazines an experiment was tried which, so far, seems to have justified the expense. Starting at the ceiling a layer of rich Portland concrete was placed, mixed very dry and tamped with the greatest care. On this was laid a coat of mastic. On the hot mastic was placed a layer of asphalt felt. Then another layer of mastic, followed by a second layer of felt, breaking joints with the first, and finally a third layer of mastic. The interior waterproof layer thus formed drains off the moisture into the air spaces around the magazines; thence it passes away through the sand.

Revetment around pits: This revetment was easily and smoothly laid by molding it in place in sections about 4 feet long and 2 feet high. The sections in each layer are arranged to break joints. This revetment is arched in rear and supported by slight piers, so there will be no cracking from settlement of sand.

Comfortable, well-ventilated guardrooms, with fireplaces, electric lights for the mortar pits and magazines, latrines, and communication by speaking tube or telephone from all points of the battery are provided.

Condition of battery on June 30: All the mass of the concrete work is done. All base rings are set and all the racers are in position. Three carriages are completely mounted, and the other five are well under way. Twelve thousand cubic yards of sand filling is in place. Work on the installation of the electric plant, ammunition conveyors, and construction of doors has been started.

DETAILS OF COST

1. *Plant.*

Water supply	$786.41	Derricks	$175.08
Railroad	7,271.39	Cars, etc	216.31
Locomotive and engines	487.64	General maintenance and repair	825.83
Boats and lighters	417.71		
Storage bins	3,021.85		
Mixer	1,498.82	Total	20,344.97
Cableway	5,643.93		

The cableway was costly, but it has paid for itself, as will be shown.

A total of 9,000 feet of track was laid.

2. *Forms for concrete.*

Labor framing	$3,491.34
Removing	421.17
Lumber	1,579.48
Nails	70.52
Total	5,562.51

Average cost of framing per thousand, $22.52. Average cost of nails per thousand, 47 cents. Average number of hours for framing 1,000 feet B. M., 100. Average cost per thousand removing forms, $2.81. Average hours of labor to remove 1,000 feet B. M., 15.

3. *Cost of concrete material stored at mixer.*

Class.	Quantity.	Unit cost.	Total cost.
Pebbles ... cubic yards	7,000	$2.53	$17,708.76
Random stone ... short tons	1,828	1.21	2,224.64
Rosendale cement ... barrels	8,477	1.044	8,816.13
Portland cement ... do	4,684	2.156	10,098.00
Sand ... cubic yards	2,000	.499	999.73
Total			39,847.26

4. *Sand filling.*

Sand filling up to June 1 was for the foundations of the battery, and amounted to 3,000 yards. The total cost, including spreading, wetting, and ramming, was $1,879.38, or 62.6 cents per cubic yard. From June 1 to June 23, 7,000 cubic yards of sand have

been placed in the parapet, at a cost of approximately 20 cents per cubic yard. This figure will be reduced when the work is completed. Even at this figure there would be a saving of 10 cents per yard as compared with the 10-inch battery, or a total of $6,000, which would more than pay for the conveyor, which cost, originally, $5,643.93.

5. *Steel beams.*

The total cost in place was $1,800.96. The labor of placing them cost $54.32, or one-half cent per pound.

6. *Waterproofing magazines.*

Labor	$276.46
Material	730.00
Total	1,006.46

Average cost per square foot, 66.4 cents.

7. *Electric plant.*

Contracts have been made for a plant of 30 kilowatts capacity. Battle lanterns and firing apparatus have been provided. Telephones have also been provided.

Total expenditures, $347.86.

8. *Miscellaneous operating expenses.*

Holidays	$666.75	Telegrams	$12.15
Fuel	1,184.47	Draft animals	457.60
Tools and nonexpendable articles	934.42	Material	532.39
Office and buildings	1,082.93	Superintendence, clerical, etc.	6,546.90
Mileage	258.14	Fender piles on wharf	136.79
Advertising	95.40	Temporary wharf	149.25
Lighting expenses	178.29	Operating mail boat	625.79
Sundries	815.88	Sundry transportation expenses	80.10
Testing cement	107.56		
Subsistence	924.01	Total	14,788.82

9. *Labor mixing concrete.*

	Cost per yard.	Total cost.
Mixing	$0.098	$881.83
Supplying cement	.031	282.28
Supplying sand	.043	389.06
Supplying pebbles	.066	595.30
Supplying water	.020	185.43
Total	.258	2,333.92

10. *Labor depositing concrete.*

Concrete proper	$4,000.11
Random stone	353.39
Total	4,353.50

This gives 44 cents per cubic yard for concrete and 19 cents per ton for stone. The total labor for mixing and placing would be, therefore, 69.8 cents per cubic yard, as compared with $1.04 on 10-inch gun battery. In placing concrete the use of the cable way has resulted in a saving of 18 cents per yard, or a total of $1,620. The cost of mixing at the mortar battery was 25 8 cents per cubic yard, as compared with 43 cents at the 10-inch battery, or a saving of 17.2 cents per cubic yard, which would give a total saving on 9,000 cubic yards of $1,548. The concrete mixing plant at the mortar battery cost $477.71 more than the plant at the gun battery, so the net saving of the improved plant was $1,070.29.

11. *Miscellaneous items in battery.*

Brick for guard rooms	$50.00
Sewerage	607.75
Doors for magazines	153.95
Ammunition conveyors (700 feet of track, 8 trolleys and blocks)	852.22
Mounting mortar carriages	970.62
Bolts and traverse circles	748.94
Speaking tubes	3.00
Total	3,386.48

Mounting mortar carriages includes loading on cars at wharf, transporting to battery, and unloading eight carriages. The labor was $912.62 and material $58.

The labor of placing and leveling eight traverse circles was $110.31. Bolts and wedges cost $638.64.

12. *Cost of concrete per cubic yard, in place.*

a. Rosendale concrete:

24 cubic feet pebbles	$2.25
10 cubic feet sand	.148
1½ barrels cement	1.566
Supplying pebbles to mixer	.066
Supplying sand to mixer	.043
Supplying cement to mixer	.031
Supplying water to mixer	.020
Mixing	.098
Placing	.440
Forms	.573
Total	5.235

b. Portland concrete:

All items would be the same as for Rosendale, except cement, which would be $3.234, making the cost per cubic yard $6.903.

13. The following is a statement of the cost of maintenance and repairs. The separate items are, however, already included under the proper classification, so the item "Maintenance and repairs" will not appear in the summary.

Material:		
Locomotives	$123.20	
Cars	172.64	
Derricks	8.60	
Sundries	17.70	
Cable way	22.13	
		$344.27
Labor		2,447.57
Total		2,791.84

14. *Comparative costs.*

	10-inch battery.	Mortar battery.
Plant	$36,316.25	$20,344.97
Material for 1 yard of Rosendale concrete	5.10	3.96
Material for 1 yard of Portland concrete	6.08	5.62
Supplying cement, per cubic yard	.08	.031
Supplying pebbles, per cubic yard	.06	.066
Supplying broken stone, per cubic yard	.08	.....
Supplying sand, per cubic yard	.03	.043
Supplying water, per cubic yard	.01	.020
Mixing concrete, per cubic yard	.17	.098
Placing concrete, per cubic yard	.62	.440
Forms for concrete, per cubic yard	.71	.573

To make the comparison just, the fact must be considered that each yard of concrete at the mortar battery contained 24 cubic feet of pebbles, 10 cubic feet of sand, and 1½ barrels of cement. At the 10-inch gun battery the corresponding quantities were 15 cubic feet of pebbles, 5 cubic feet of sand, and 1½ barrels of cement.

The mortar battery had also the advantage of a large amount of plant for which the 10-inch gun battery had paid.

15. *Summary.*

Plant	$20,344.97	Electric plant	347.86
Forms	5,562.51	Mixing concrete	$2,333.92
Material for concrete	39,847.26	Placing concrete	4,353.50
Sand filling	1,879.38	Miscellaneous items in battery	3,386.48
Steel beams	1,800.96	Sundry items	1,731.62
Waterproofing	1,006.46		
Miscellaneous operating expenses	14,788.82	Total	97,383.74

In concluding, I wish to call attention to the valuable and willing services of the force of superintendents, office force, and master laborers.

It is but justice to Lieutenant Jervey to say that although his methods of carrying on the work at this battery were submitted for approval, they were designed and carried out solely by himself.

Money statement.

July 1, 1897, balance unexpended		$22,780.01
June 30, 1898, amount allotted during fiscal year		119,700.00
		142,480.01
June 30, 1898, amount expended during fiscal year		117,710.87
June 30, 1898, balance unexpended		24,769.14
June 30, 1898, outstanding liabilities	$7,383.58	
June 30, 1898, amount covered by uncompleted contract	7,638.03	
		15,021.61
July 1, 1898, balance available		9,747.53

Abstract of bids received and opened by Maj. F. A. Mahan, Corps of Engineers, United States Army, on September 22, 1897, for furnishing and delivering material for mortar battery.

No.	Name of bidder and post-office address.	Class A, Portland cement.	Class B, natural cement.	Class C, broken stone.		Class D, pebbles.	Class E, fertile earth.
				Ordinary.	Granolithic.		
		Per barrel.	*Per barrel.*	*Per cubic yard.*	*Per cubic yard.*	*Per cubic yard.*	*Per cubic yard.*
1	Bond, Harrison & Co., Savannah, Ga	*a* $2.25	*b* $1.19	$3.20	$3.50		
2	Lawrenceville Cement Co., New York, N. Y	*c* 2.40	*d.* 95				
3	New York and Rosendale Cement Co., New York, N. Y		*e.* 99				
4	Western Cement Co., Louisville, Ky		*f.* 92				
5	M. P. Palms, Pensacola, Fla					1.70	
6	Fred. F. Visscher, Montgomery, Ala. Regular					2.55	1.45
	Fred. F. Visscher, Montgomery, Ala. Alternative					2.10	.85
7	Chas. G. Smith & Son, Washington, D. C			3.19	3.19	3.76	
10	Simmons & Mayrant, Charleston, S. C. Regular					2.78	.99
	Simmons & Mayrant, Charleston, S. C. Alternative					2.08	

No.	Name of bidder and post-office address.	Class F, steel beams.			Class G, steel anchorage bolts.*g*		Class I, bronze castings.
		Steel I-beams.	Steel T-beams.	Standard connection and angles for 8-inch I-beams.	Bolts.	Cast-iron washers.	
		Per lb.	*Per lb.*	*Per lb.*	*Per lb.*	*Per lb.*	*Per lb.*
8	Thompson C. Gill & Co., Philadelphia, Pa	$0.0424	$0.0424	$0.0424	$0.0499	$0.0399	$0.32

a Paragon. *b* Newark. *c* Knickerbocker. *d* Beach. *e* Hudson River. *f* Louisville.
g Class H, trolleys and rail; no proposal received. * Accepted.

Abstract of bids received and opened by Maj. F. A. Mahan, Corps of Engineers, United States Army, on September 22, 1897, for furnishing and delivering material for mortar battery—Continued.

No.	Name of bidder and post-office address.	Class J, electric plant.							
		Dynamos and engines.	Boilers.	Storage battery.	Pump.	Blower.	Lamps.	Switch board, testing apparatus, wiring, etc.	Total for plant in place, complete, including testing.
9	General Electric Co., Atlanta, Ga	*Each.* $1,140	*Each.* $415	*Each.* $1,055	*Each.* $108	*Each.* $145	*Each.* $8.36	$1,067.64	*6,474

No.	Name of bidder and post-office address.	Class K, plumbing supplies.										
		Closets.	Cast-iron water pipe.	Cast-iron water pipe fittings.	Cast-iron soil pipe.	Cast-iron soil pipe fittings.	8-inch vitrified sewer pipe.	Fittings for 8-inch vitrified sewer pipe.	Ventilator hoods.	12-inch vitrified sewer pipe.	Cast-iron manholes.	Cast-iron gratings.
		Each.	*Cents per lb.*	*Cents per lb.*	*Cents per lb.*	*Cents per lb.*	*Cents per foot.*	*Per lot.*	*Each.*	*Cts. per foot.*	*Each.*	*Each.*
8	Thompson C. Gill & Co., Philadelphia, Pa	$25.00	1.94	4	1.99	4	10	$4.00	$4.00	17	$8.00	$15.00

No.	Name of bidder and post-office address.	Class K, plumbing supplies—Continued.									
		2-inch galvanized-iron pipe.	1-inch galvanized-iron pipe.	Galvanized-iron pipe fittings.	Yard hydrants.	Globe valves.	Brass speaking tubes.	Flexible speaking tubes.	Mouthpieces.	1¼-inch brass tees.	1¼-inch brass collars.
		Cents per ft.	*Cents per ft.*	*Cents per lb.*	*Each.*	*Each.*	*Cents per ft.*	*Cents per ft.*	*Each.*	*Each.*	*Each.*
8	Thompson C. Gill & Co., Philadelphia Pa	12¼	6	10	$10.00	$2.00	25	40	$1.25	$1.00	$1.00

No.	Name of bidder and post-office address.	Total of respective bids, classes—						
		A	B	C	D	E	F	G
1	Bond, Harrison & Co., Savannah, Ga	$7,520	$11,305	*a* $402.50 *b* 13,760.00				
2	Lawrenceville Cement Co., New York, N. Y	7,680	9,025					
3	N. Y. and Rosendale Cement Co., New York, N. Y		9,408					
4	Western Cement Co., Louisville, Ky		8,740					
5	M. P. Palms, Pensacola, Fla				$7,310			
6	Fred. F. Vischer, Montgomery, Ala. Regular				10,965	$4,350		
	Fred. F. Vischer, Montgomery, Ala. Alternative				9,030	2,550		
7	Chas. G. Smith & Son, Washington, D. C			*b* 13,717.00 *a* 366.85	16,168			
8	Thompson C. Gill & Co., Philadelphia, Pa						$3,534.46	$1,700
10	Simmons & Mayrant, Charleston, S. C. Regular				11,954	2,970		
	Simmons & Mayrant, Charleston, S. C. Alternative				8,944			

* Accepted. *a* Granolithic. *b* Ordinary.

Abstract of bids received and opened by Maj. F. A. Mahan, Corps of Engineers, United States Army on September 22, 1897, for furnishing and delivering material for mortar battery—Continued.

No.	Name of bidder and post-office address.	Total of respective bids, classes—				Points of delivery and remarks.
		I	J	K	Total.	
1	Bond, Harrison & Co., Savannah, Ga.	.....	.....	.....	$32,987.50	Point of delivery not stated.
2	Lawrenceville Cement Co., New York, N. Y.	.....	.....	.....	16,705.00	Delivered at wharf at site.
3	N. Y. and Rosendale Cement Co., New York, N. Y.	.....	.....	.....	9,408.00	Delivered at wharf at site.
4	Western Cement Co., Louisville, Ky.	.....	.....	.....	8,740.00	Delivered at railroad depot, Pensacola, Fla.
5	M. P. Palms, Pensacola, Fla.	.....	.....	.....	7,310.00	No point of delivery stated. Bidder's bond not signed.
6	Fred. F. Visscher, Montgomery, Ala. Regular	.....	.....	.....	15,315.00	Delivered at wharf at site.
	Fred. F. Visscher, Montgomery, Ala. Alternative.	.....	.....	.....	11,580.00	Delivered at Pensacola, Fla.
7	Chas. G. Smith & Son., Washington, D. C.	.....	.....	.....	30,251.85	Delivered at wharf at site.
8	Thompson C. Gill & Co., Philadelphia, Pa.	$128	.....	$1,100	6,462.46	Delivered at Pensacola, Fla.
9	General Electric Co., Atlanta, Ga.	.....	$5,803.32 6,474.00	.....	5,803.32 6,474.00	*a* Delivered at Pensacola, Fla. *b* In place.
10	Simmons & Mayrant, Charleston, S. C. Regular	.....	.....	.....	14,924.00	Delivered f. o. b. lighters, wharf at site.
	Simmons & Mayrant, Charleston, S. C. Alternative.	.....	.....	.....	8,944.00	Delivered f. o. b. cars at Pensacola, Fla.

a Regular. *b* Alternative.

Abstract of contracts in force.

Name and address of bidder.	Character of work.	Date of approval.	Work begun.	Expires.
Lawrenceville Cement Co., New York, N. Y. *a*	9,500 barrels American natural cement.	Nov. 22, 1897	Dec. 1, 1897	Jan. 15, 1898
General Electric Co., Schenectady, N. Y. *b*	Electric plant	Jan. 13, 1898	.....	Mar. 1, 1898

a In force pending settlement for broken and damaged barrels.
b In force pending completion of battery.

NATIONAL DEFENSE.

Telegraphic instructions for building a battery for two 12-inch guns and one for two 8-inch guns were received on March 18, 1898.

Machinery and materials were ordered at once by telegraph, and work was begun as soon as possible.

Instructions by letter for the construction of a battery for two 4.7-inch rapid-fire guns were received on March 21, 1898.

The condition of the work on June 30, 1898, on the 12-inch and rapid-fire batteries was as follows:

Twelve-inch gun battery.—All the concrete work is done in the right (first) emplacement, and all the forms have been removed. The gun platform and all the foundations of the left (second) emplacement are finished. The forms for the concrete are all up. The derricks have been removed from the first emplacement to positions where they can handle best the concrete for the second.

Battery for two 4.7-inch R. F. guns.—This work is finished.

The items of cost stated in Lieutenant Jervey's report are incomplete, as is to be expected from unfinished work. Enough is given, however, to show that the work which he has done has been carried on most economically, especially in view of the necessarily extra cost of work done in a hurry, and confusion resulting from trying to handle materials for three batteries, all at the same time, in a space barely large enough to move economically those for one battery.

This work would not have been done as it has been, except for the intelligent direction and the constant, careful attention which it received from Lieutenant Jervey, whom the officer in charge commends highly.

EXTRACT FROM REPORT OF FIRST LIEUT. JAMES P. JERVEY, CORPS OF ENGINEERS.

Fifty thousand dollars for the construction of battery for 12-inch guns on disappearing carriages, and $6,000 for construction of battery for two 4.7-inch Nordenfeldt guns, were allotted from the appropriation for "National Defense," act of March 9, 1898.

Instructions were received on March 18, 1898, to commence work. As the work at the mortar battery was not completed, a complete new plant was necessary. Work has been carried on as rapidly as possible, the only difficulty encountered being the scarcity of labor.

Construction methods: In building the rapid-fire battery, as the amount of work was small, the concrete was mixed by hand and placed by wheelbarrows.

On the 12-inch battery, a cubical mixer of one cubic yard capacity was used. The dry material is measured in small handcarts, dumped into a tub, raised over the mixer by a derrick, mixed, dumped into a tub resting on a flat car, run out under derricks on the work, and placed in position without rehandling. The placing is accomplished cheaply and quickly by using the system of running lines on the derricks as suggested by you—that is, two hoisting lines are placed on each derrick, so that the bucket of concrete can be dumped anywhere in the area covered by the derrick. Material is stored in the vicinity of the mixer by two derricks.

Results: The rapid-fire battery is complete and the guns are mounted. Both gun platforms in the 12-inch battery are finished, and in emplacement No. 1 the loading platform is completed. All concrete work on emplacement No. 1 is completed. The foundations and paving in emplacement No. 2 are finished. A total of 6,200 cubic yards of concrete has been laid, up to and including June 30, 1898.

Two thousand yards of sand filling in the rapid-fire battery and 1,000 in the 12-inch battery are in place.

On account of the hurried nature of the work the report of costs of items is not as complete as could be desired.

The following summaries show distribution of labor and costs of various materials to May 31, 1898:

Class of labor.

Maintenance and repairs	$182.00	Policing	$50.00
Lights and condensing plant	931.00	Water tanks	128.25
Placing hoisting engines	75.00	Moving rapid-fire guns	129.00
Blacksmith work	268.75	Handling boilers for McRee	15.00
Receiving wood	150.00	Mixing concrete	160.00
Receiving gravel	963.00	Leveling and clearing site	250.00
Receiving sand	814.75	Building and removing forms	1,237.62
Receiving lumber	264.50	Erecting derricks	204.50
Receiving cement	1,425.50	Buildings and tents	306.05
Sand filling	731.50	Overseers, clerks, timekeepers, electrician, enginemen, master laborers, watchmen, cook, and waiters	2,500.00
Concreting	4,018.00		
Placing beams	32.50		
Storing sundries	10.50		
Supplying cement to mixer	105.00		
Supplying pebbles to mixer	200.00	Total	15,207.42
Supplying sand to mixer	55.00		

Total labor on each work.

Rapid-fire battery	$2,557.50
12-inch battery	12,649.92
Total	15,207.42

Expenditures for material, etc.

Office outfit	$73.27	Plant	$4,879.09
Montgomery office	250.00	Pipe and fittings	460.99
Telegrams	17.59	Iron, steel, and nuts	135.18
Traveling expenses	57.35	Nails (55 kegs)	117.80
Electrical supplies	720.14	Provisions	907.45
2,000 yards of gravel	3,400.00	Oils, waste, pomade	60.48
4,000 barrels Portland cement	10,315.00	Towing	817.72
Sundries	813.49		
Lumber (155,861 feet)	1,910.66	Total	24,936.21

Total expenditures for material on each work.

12-inch battery	$20,718.19
4.7-inch battery	4,218.02
Total	24,936.21

Liabilities.

Lumber	$3,378.72	Condenser	$48.99
Miscellaneous supplies	1,587.83	Electrical supplies	889.18
Provisions	867.97	Wood	192.90
Castings	48.70	Telegrams	24.52
Maintenance and repairs	159.70	Steel beams	2,122.14
Meat	164.62	Cement (7,809 barrels)	9,849.45
Car wheels	260.02	Gravel (2,000 yards)	3,400.00
Hoisting tubs	60.00	Total	24,242.64
Coal	30.20		
Delivery of material	1,157.70		

Cost of items.

Plant:

Labor	$728.80
Material	5,340.08
Liabilities	817.71
Towing	817.72
Total	7,704.31

Lumber:

First cost	$1,910.66
Labor unloading	264.50
Liabilities	3,378.72
Total	5,553.88

Total received, 400,000 feet B. M.; average cost delivered, $13.88 per M.

Cement:

First cost	$10,315.00
Labor unloading	1,425.50
Liabilities	9,849.45
Total	21,589.95

Total received, 11,809 barrels; average cost delivered, $1.83 per barrel.

Pebbles:

First cost	$3,400.00
Labor unloading	963.00
Liabilities	4,557.70
Total	8,920.70

Total received, 4,000 yards; average cost per yard, $2.25.

Sand: Labor $814.75

Total stored, 2,000 cubic yards; average cost per yard, 40.7 cents.

Sand filling: Labor $731.50

Amount placed, 3,000 cubic yards; average cost per yard, 24.4 cents.

Supplying material to mixer:

Labor $360.00

Total number of yards mixed, 2,000; average cost per yard, 18 cents.

Placing concrete:

2,000 yards at 12-inch battery	$2,321.00
1,000 yards at 4.7-inch battery	1,697.00
Including all labor, mixing, and framing.	4,018.00

Average cost per yard, 12-inch battery, $1.16; average cost per yard, rapid-fire battery, $1.69.

Mixing concrete by machinery:

Labor $160.00

Total mixed, 2,000 yards; average cost per yard, 8 cents.

Building forms:

Labor $1,237.62

Forms for 4,000 yards; average cost per yard, 30.9 cents.

Placing roof beams:

Labor	$32.50
Liabilities	2,122.14
Total	2,154.64

Maintenance and repair:

Repairs to locomotive	$76.50
Blacksmithing	268.75
Repair of tracks	75.00
Repair to cars, etc	30.50
Liabilities	159.70
Material	948.67
Total	1,559.12

Lights and condensing apparatus:

Labor	$931.00
Material	720.14
Liabilities	889.18
Total	2,540.32

Receiving fuel:

Labor	$150.00
Liabilities (wood)	192.90
Liabilities (coal)	30.20
Total	373.10

Subsistence:

Provisions	$907.45
Liabilities	1,032.59
Total	1,940.04

Sundry labor items:	
Storing sundries	$10.50
Policing	50.00
Moving 4.7-inch guns	129.00
Leveling sites	250.00
Superintendence	2,500.00
Total	2,939.50

Sundry expenditures:	
Office expenses	$323.27
Telegrams	17.59
Traveling expenses	57.35
Nails	117.80
Oil, waste, etc	60.48
Total	576.49

Sundry liabilities:	
Miscellaneous supplies	$1,187.83
Telegrams	24.52
Total	1,212.35

Average estimate of cost of 1 yard of concrete in place, 12-inch battery:	
24 feet of gravel	$2.00
1½ barrels cement	2.75
10 feet sand	.15
Forms, labor	.309
Material (lumber)	.350
Nails	.015
Supplying material to mixer	.18
Mixing concrete	.08
Placing concrete	1.16
Total	6.994

Estimate of average cost of 1 yard of concrete in 4.7-inch battery:	
24 feet gravel	$2.00
Cement	3.00
Sand	.15
Lumber	.35
Nails	.015
Labor	1.69
Total	7.205

SUMMARY.

Plant	$7,704.31
Lumber	5,553.88
Cement	21,589.95
Pebbles	8,920.70
Sand for concrete	814.75
Sand filling	731.50
Supplying mixer	360.00
Mixing	160.00
Placing	4,018.00
Forms, building	1,237.62
Ceiling beams	2,154.64
Maintenance and repair	1,559.12
Fuel	373.10
Lights and water	2,540.32
Subsistence	1,940.04
Sundry labor	2,939.50
Sundry material	576.49
Sundry liabilities	1,212.35
Total	64,386.27

Total expenditures and liabilities for each work.

12-inch battery:		
Labor		$12,649.92
Material		20,718.19
Liabilities		23,886.27
Total		57,254.38
4.7-inch battery:		
Labor	$2,557.50	
Material	4,218.02	
Liabilities	356.37	
		7,131.89
Total of both batteries		64,386.27

Battery for two 8-inch guns on disappearing carriages.—As work in connection with Pensacola Harbor had become somewhat slack, Mr. J. E. Turtle, United States assistant engineer, was directed to take charge of the construction of this battery.

The work at this point labored under two disadvantages: First, the position of the landing place, exposed to the sea; second, having no wharf at which to land even when the sea would permit. All materials had to be brought, at first, into the lagoon on the north side of the site of the work. This could be accomplished only at high tide and during smooth water. This state of affairs has frequently caused delays of two or three days in sending material to the battery.

A wharf had to be built first. It was begun April 18 and finished May 14, ready for the rails. These latter had been ordered immediately from the American Rail Trust Company, of Atlanta, Ga. These parties dillydallied about delivering and made all sorts of excuses for not doing so. Patience and time being more than exhausted, the order was countermanded and placed elsewhere. All this caused great delay and inconvenience and increased expense. However, the gun platforms were finished and ready for the guns by May 24.

As much of the site of the battery was covered with muck, grass, weeds, etc., it had to be cleared of all this and the foundations had to be started at (2.70) instead of at (4.00), as was intended originally.

As the foundations of the main or parapet wall are at (6.0), it was necessary to put in much sand filling to raise parts of the site to this level, 6,700 cubic yards being required in all. Nine-tenths of this is in place.

All the concrete work for the foundations of the magazines, passages, is in, and the forms are all up for the rest of the concrete.

The railroad tracks are all laid, derricks built, concrete mixer in place, and all preliminaries finished.

Mr. Turtle has been unremitting in his care of and attention to the work, which he has directed with much skill under trying and difficult circumstances.

Money statement.

June 30, 1898, amount allotted during fiscal year	$199,750.00
June 30, 1898, amount expended during fiscal year	90,650.73
June 30, 1898, balance unexpended	109,099.27
June 30, 1898, outstanding liabilities	47,214.87
July 1, 1898, balance available	61,884.40

Preservation and repair of fortifications.—At one of the works of old type the porch in front of the officers' quarters was rebuilt, two casemates were repaired, and 60 square yards of paving on the barbette was relaid.

At another old fort the wooden sidewalk from the west gate of the post to the entrance to the fort was replaced with one of concrete. The loading platforms of the 15-inch smoothbore guns were renewed. A flight of steps was built from the 15-inch battery up to the ditch of the fort. Two shot beds, each to hold 60 projectiles, were made for the 15-inch battery. The old Spanish fort was thoroughly overhauled and restored so far as possible.

Money statement.

July 1, 1897, balance unexpended	$928.20
June 30, 1898, amount allotted during fiscal year	2,225.00
	3,153.20
June 30, 1898, amount expended during fiscal year	2,185.64
June 30, 1898, balance unexpended	967.56
July 1, 1898, outstanding liabilities	967.56

4 P.

DEFENSES OF MOBILE AND MISSISSIPPI SOUND.

Officer in charge, Maj. William T. Rossell, Corps of Engineers; assistant, Lieut. James B. Cavanaugh, Corps of Engineers; Division Engineer, Brig. Gen. Peter C. Hains, United States Volunteers, Colonel, Corps of Engineers.

Shore protection: By letter of the Chief of Engineers, dated September 5, 1896, $5,000 was allotted from appropriation for "Preservation and Repair of Fortifications," act of June 6, 1896, to be expended in shore protection at Forts Morgan and Gaines.

By letter of the Chief of Engineers, dated March 22, 1897, $20,000 was allotted from appropriation for "Sea Walls and Embankments," act of March 3, 1897, to be expended in shore protection at Forts Morgan and Gaines.

At Fort Gaines 4,629.9 square yards of fascine mattress and 1,989 cubic yards of stone were placed in sea wall and jetties during the fiscal year, under supplemental contract with W. Chase Spotswood, approved June 23, 1897, completing all shore protection work at present contemplated at that fort.

The completion of the work at Fort Gaines left a balance of $7,279.84 for expenditure at Fort Morgan. Proposals were accordingly invited for putting in about 1,000 feet of sea wall, the construction to be similar to that used at Fort Gaines, and contract entered into on February 26, 1898, with B. O. Watkins, of Birmingham, Ala., for the work. Under this contract, 1,988.8 square yards of fascine mattress, and 1,325.9 cubic yards of rock were put in place, completing the wall from the base of the old wharf to a point 895 feet to the eastward. The beach beyond this point is cutting away, so that an extension of the wall is needed and will be made in the near future, as it is expected that funds will soon be allotted for the purpose.

Fence: During the fiscal year the small balance remaining from the original allotment was expended in repairs to main line of fence and the construction of a connection with old fence at southeast salient of Fort Morgan.

Repair of platforms: By letter of Chief of Engineers, dated June 14, 1897, $3,000 was allotted from the appropriation for "Preservation and Repair of Fortifications," act of March 3, 1897, for repairing platforms for 8-inch converted rifles and other most necessary work included in estimate submitted December 21, 1896. During the year the platforms were repaired and strengthened by repointing brick masonry, surrounding pintle block with concrete, and repairing or renewing iron traverse circles. The additional platforms required for carriages on hand were practically reconstructed. New pintle blocks were prepared, set in mortar, and then strongly reenforced by surrounding them with concrete, and the traverse circles repaired.

Upon receipt of the guns for these platforms the 200-pounder Parrotts and carriages already mounted on the platforms were dismounted, and the 8-inch converted rifles and carriages were mounted and turned over to the artillery garrison for service.

Money statements.

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1897, balance unexpended	$3,213.44
June 30, 1898, amount expended during fiscal year	2,908.78
July 1, 1898, balance unexpended	304.66

SEA WALLS AND EMBANKMENTS.

July 1, 1897, balance unexpended	$20,000.00
June 30, 1898, amount expended during fiscal year	19,291.55
July 1, 1898, balance unexpended	708.45

Abstract of proposals for construction of shore protection at Fort Morgan, Ala.

No.	Name and place of residence of bidder.	Stone in place in sea wall.	Fascine mattresses in place in sea wall.
		Per cu. yd.	*Per sq. yd.*
1	B. O. Watkins, Birmingham, Ala	$4.50	$0.30
2	W. Chase Spotswood, Mobile, Ala	3.20	1.25

Battery for 8-inch guns mounted on disappearing carriages.—The approved project provides for the construction of a four gun battery for 8-inch guns mounted on disappearing carriages, at an estimated cost of $275,000. Emplacements and platforms 1 and 2 are for carriages, model 1894, and emplacements and platforms 3 and 4 for carriages, model 1896.

The battery is now practically finished, and has been transferred to the artillery garrison for service.

To complete it entirely about 7,500 cubic yards of sand are to be placed in the parapet and the parapet covered with loam and sodded. The rear part of the parade is to be graded and the installation of the electric-lighting plant finished. The necessary funds for this work have been allotted, and it will all be completed early in the coming fiscal year.

The operations on the different parts of the battery during the year were as follows:

Emplacement 1: Trolley system was installed, magazine doors constructed and hung, and interior walls painted with two coats asbestine paint; 77.99 cubic yards of concrete, including 38 square yards of granolithing, was placed in flank wall, closing gap left for railroad, completing concrete work of emplacement.

Platform 1: The trolley system, ammunition cranes, and railings were put in place, shot-room doors constructed and hung, and interior walls painted with asbestine paint. The base ring and traverse circles for carriage were set and the carriage and gun mounted and cared for till transferred to the artillery garrison.

Emplacement 2: The trolley system was installed, magazine doors constructed and hung, and interior walls painted with asbestine paint.

Platform 2: The trolley system, ammunition cranes, and railings were put in place, shot-room doors constructed and hung, and interior walls painted with asbestine paint. The base ring and traverse circles for carriage were set and the carriage and gun mounted and cared for till transferred to the artillery garrison.

Emplacement 3: The superior slope and left platform level were granolithed, using 128.97 cubic yards of concrete, making 604 square yards of granolithing. The ammunition lifts and the trolley system were installed, magazine doors were constructed and hung, and interior walls painted with asbestine paint.

Platform 3: The construction of the platform was completed, 521.8 cubic yards of concrete, including 226 square yards of granolithing, being put in place. The trolley system, ammunition cranes, and rail-

ing were put in place, iron stairways erected, doors constructed and hung, and interior walls painted with asbestine paint. The base circle of carriage was set and the carriage and gun mounted and cared for till transferred to the artillery garrison.

Emplacement 4: The concrete on emplacement was finished, 945.55 cubic yards of concrete, including 495 square yards of granolithing, being put in place. The ammunition lifts and the trolley system were installed, magazine doors were constructed and hung, and the interior walls painted with asbestine paint.

Platform 4: The construction of the platform was completed, 537.33 cubic yards of concrete, including 250 square yards of granolithing, being put in place. The trolley system, ammunition cranes, railings, and the iron stairway were erected, doors constructed and hung, and interior walls painted with asbestine paint. The base circle of carriage was set, the carriage and gun mounted and cared for till transferred to the artillery garrison.

In addition to the work on emplacements and platforms proper, that part of the parade immediately in rear of the battery was graded, the concrete pavements and steps put in, and the slope fertilized and sodded; 153.93 cubic yards concrete, including 467 square yards granolithing, 539 cubic yards of sand, and 360 square yards of sod were put in place, and 1,140 cubic yards of sand excavated.

The total amount of concrete placed in the battery during the year, including 2,080 square yards of granolithing, was 2,364.57 cubic yards.

A sand track about 2,900 feet long, including 882½ feet of trestle, was built, and 15,240 cubic yards of sand placed in parapet.

About the middle of September work was practically suspended on account of the yellow fever and was not resumed until December; and as the available funds were insufficient to complete the battery, operations were confined to the most essential parts, leaving the completion of the sand parapet until more funds became available. By indorsement of Chief of Engineers, dated June 15, 1898, $10,000 was allotted for the completion of the battery, and work was actively resumed on sand parapet. On February 24, 1898, by indorsement of Chief of Engineers, $3,700 was allotted for an electric-lighting plant. The necessary machinery and electrical supplies were at once contracted for, but have not all been received. The oil engine, dynamo, and switch board have been installed, holes drilled for conduit, and the installation of the remainder of the plant is in progress.

By indorsement of the Chief of Engineers, dated December 9, 1896, $1,000 was allotted from appropriation for "Gun and Mortar Batteries," act of June 6, 1896, for repairing and strengthening wharf so as to admit of receiving 8-inch B. L. rifles and carriages.

During the fiscal year the small balance of this allotment on hand from last year was expended in minor repairs to solid causeway of wharf.

Money statement.

July 1, 1897, balance unexpended	$28,891.51
Amount allotted during fiscal year	16,500.00
	45,391.51
June 30, 1898, amount expended during fiscal year	30,850.14
July 1, 1898, balance unexpended	14,541.37
July 1, 1898, outstanding liabilities	2,631.10
July 1, 1898, balance available	11,910.27

Emplacements for 4.7-inch rapid-fire guns.—From the appropriation for "National Defense," act of March 9, 1898, a provisional allotment of $6,000 was made by letter of Chief of Engineers, dated April 6, 1898, for the construction of emplacements for two 4.7-inch rapid-fire guns on pedestal mounts. As soon as the location of the battery was approved work was begun. The necessary retaining walls and portions of emplacements necessary to confine the sand in foundations of platforms were built, 100 cubic yards of sand excavated, and 405 cubic yards put in place. The platforms were then constructed and were completed ready for the guns on April 26, 1898. The guns and carriages were received May 1, 1898, and were mounted ready for service May 9, 1898. In order to give them the necessary protection the concrete portion of parapet, with the exception of the blast apron, was then completed. Six hundred feet of railroad track, including 100 feet of trestle, were built from the main line up to site of battery, and 1,779 cubic yards of sand placed in the parapet. To keep sand from running into ditch of the old fort a light retaining wall, about 20 feet high, was built on top of counterscarp wall. This will require to be strengthened before braces are removed.

All the concrete placed in the battery to this point was mixed by hand and carried to the site by an inclined railroad, operated by a hoisting engine. As this method was very expensive and the battery was then in serviceable shape, with guns mounted and fully protected, concrete work was suspended and an inclined switch put in so that the concrete could be taken from the mixers of the plant for the 12-inch battery, which were being put in place, and hauled with a locomotive to the battery. As the funds originally allotted were practically exhausted, an additional allottment of $9,000 was made for the completion of the battery.

On June 14, 1898, concrete work was resumed. The magazines were completed to a point about 2½ feet above the ceiling level, arched over and troweled smooth. After this upper surface had set sufficiently to be perfectly hard and dry it was thoroughly waterproofed with four layers of asphaltic cement and felt. This waterproof roof empties into blind drains in the concrete, which in turn connect with tile drains that carry all the seepage water outside the magazine walls.

The work yet to be done on the battery comprises the concrete blast apron and sodding on parapet, buttresses for the high retaining wall, a small amount of concrete and granolithing over magazine, the construction of steps, and the grading and sodding of slopes in rear of battery; also the installation of the lighting plant and the minor details, such as railings, ladders, doors, etc. Everything will be completed early in the coming fiscal year.

Money statement.

Amount allotted during fiscal year	$15,000.00
June 30, 1898, amount expended during fiscal year	4,281.98
July 1, 1898, balance unexpended	10,718.02
July 1, 1898, outstanding liabilities	3,346.97
July 1, 1898, balance available	7,371.05

Battery for two 12-inch rifles.—By letter of Chief of Engineers, dated March 18, 1898, a provisional allotment of $50,000 was made from the appropriation for "National Defense," act of March 9, 1898, for construction of emplacements for two 12-inch guns mounted on disappearing carriages, model 1896.

The location of the emplacements and their general plan were submitted and approved, estimates for their construction submitted, and on March 30, 1898, a subsequent allotment of $50,000 was made by indorsement of Chief of Engineers.

As the existing wharf was entirely too small to permit of a rapid execution of the work and too weak to receive the 12-inch guns and carriages, a new creosoted pile wharf 625 feet long, reaching to the edge of the deep-water channel, was constructed, at a total cost of $9,181.74. The creosoted piles, lumber, and other materials were purchased in open market and the work done under oral agreement.

The machinery, lumber, and other materials for necessary plant and buildings were purchased in open market, and installation begun as fast as received. Arrangements were also made for the purchase of gravel, stone, cement, steel work, and framing lumber for concrete, and to supply immediate needs 2,991 barrels of cement, belonging to the improvement of Tombigbee River, Alabama, in store at McGrews Shoals, were transferred to this work.

The following new buildings were constructed: One barracks for laborers, 150 feet by 18 feet; one tool and store room, 50 feet by 20 feet; one provision house, 30 feet by 20 feet; one extension to mess hall, 50 feet by 20 feet, and an extension to cement house, 80 feet by 46 feet. For receiving and storing sand and gravel twelve bins, 12 feet by 12 feet by 20 feet, were built. A full-circle stiff-leg derrick of 3 tons capacity was erected upon the pierhead of the new wharf, and a railroad track 1,700 feet long, including 1,000 feet of trestle, built from there over the parapet and along the eastern face of the fort above the bins, so that material can be dumped not only into the bins, but also upon the brick terreplein of the barbette battery, from which it can be readily shoved into the bins, thus materially increasing their storage capacity. A switch was also laid from the inner end of the wharf through the cement house and extension, connecting with the tracks already in position.

For mixing concrete two cubical box mixers were installed immediately in the rear of center of the battery, each provided with a separate driving engine. For collecting the charge and delivering the same to mixers, two charge cars of 50 cubic feet capacity, one for each mixer, were constructed. A track for these cars was laid in rear of the material bins, and the sand and gravel is delivered in the cars by means of chutes which extend out over the track. To get the cars up to the mixer platforms a light double-track incline was built, its two tracks being connected with track in rear of bins by two turntables near the center. To store the daily supply of cement, and deliver it conveniently to charge cars, a cement house 20 feet by 40 feet was built across the lower end of the incline. Two hoppers provided with valves were placed in the floor, one over each track, and the cement is dumped from these hoppers upon the sand in the loaded cars just before they start up the incline. The incline is operated by two separate engines, one for each track, and the charge cars are automatically dumped by stops which open the valves in the bottoms of the cars where they come over the hoppers of the mixers.

To furnish water for concrete and steam purposes a well was dug and a Smith-Vaile duplex pump installed. The pump discharges into an elevated tank, which supplies the mixers and engines, and also into a pipe line along the rear of the battery with hose connections for wetting down concrete and bowlders.

To supply steam for mixer and incline engines and steam-pump a

21-horsepower locomotive boiler was installed. One of the incline engines is an ordinary Lidgerwood hoisting engine with boiler attached, and connections have been made so that one mixer can be operated by steam from this in case of accident to large boiler. In this way duplication of mixing plant has been secured.

For filling sand in parapet and placing concrete and other materials in position a Lidgerwood cable way of 3 tons capacity and 350 feet span, with traveling towers, was installed, so as to control the whole area covered by the battery.

Previous to the installation of the concrete plant work was started upon both platforms. The necessary retaining walls were built, foundations filled in with sand, and work commenced on platforms proper. The hold-down bolts were received and set and 160 cubic yards of concrete placed by hand before the first mixer was started. The remainder of concrete in the platforms was mixed by machine and placed by a derrick temporarily erected for the purpose. After the completion of the platforms ready for the guns concrete work was suspended to wait for complete installation of plant, the mixer being used for work on the rapid-fire battery.

Money statement.

Amount allotted during fiscal year	$125,000.00
June 30, 1898, amount expended during fiscal year	60,224.98
July 1, 1898, balance unexpended	64,775.02
July 1, 1898, outstanding liabilities	52,373.61
July 1, 1898, balance available	12,401.41

Battery for two 8-inch rifles on 15-inch smooth-bore carriages.—From the appropriation for "National Defense," act of March 9, 1898, an allotment of $6,000 was made by letter of Chief of Engineers, dated April 27, 1898, for the construction of two emplacements and platforms for two 8-inch B. L. rifles, mounted on modified 15-inch Rodman gun carriages. Due to the entire absence of wharf and other facilities, this allotment was too small to cover cost of preliminary work, therefore a subsequent allotment of $6,000 was made by indorsement of Chief of Engineers, dated May 25, 1898.

A creosoted pile wharf 150 feet long, reaching to depth of 7 feet at low water, was completed June 29, and a stiff-leg derrick erected on pierhead of same. The necessary materials for the work have been contracted for and active operations will begin at once.

Money statement.

Amount allotted during fiscal year	$12,000.00
July 1, 1898, balance unexpended	12,000.00
July 1, 1898, outstanding liabilities	2,138.91
July 1, 1898, balance available	9,861.09

Casemate and cable gallery.—At the beginning of the fiscal year the casemate and cable gallery were completed. During the year there were received and stored buoyant torpedoes, tools and tool boxes, electrical instruments, and various torpedo materials and supplies. The interior walls of the casemate were painted with two coats of asbestine paint, necessary shelves and tables put in place, and the casemate fitted up for operating mines on the Abbot system.

Cable tank.—With funds allotted by indorsement of Chief of Engineers, dated May 13, 1897, a concrete tank for the storage of cable was built during the year; 211 cubic yards of sand were excavated and

204.4 cubic yards of Portland cement concrete, including 90 square yards of granolith, were put in place. The tank is 15 feet by 42 feet on the bottom, flaring to 17 feet by 44 feet on top, and 7 feet deep. The thickness of the bottom is 2 feet and of the walls from 3 feet 6 inches at the bottom to 2 feet 6 inches at the top.

To supply the tank with water, a well was dug a short distance from the tank to a depth of about 3 feet below low water, and a pump driven by a windmill installed. As the level of the water in the well can never rise much above the water in the bay, less than 100 feet distant, the well is made to serve as an emptying basin for the tank, the outer end of the discharge pipe and emptying valve being placed inside the curbing. This obviates the necessity of putting the discharge pipe through the concrete sea wall, and in practice works very satisfactorily. Considerable leakage was found in the walls of tank at first, but this was stopped by thoroughly coating the interior faces with solutions of soap and alum.

A substantial frame building was built over the tank, and, to facilitate the handling of cable, a spur from the railroad track was laid to the end of the tank and a traveling crane of 3 tons capacity and 20 feet span installed, so as to carry the cable from the cars on this spur to any point in the tank.

Repair of casemates.—During the fiscal year, with funds allotted by indorsement of Chief of Engineers, dated June 15, 1897, three casemates were cleaned and repaired for the storage of torpedo material. One casemate for the smaller and more delicate apparatus was ceiled throughout, and fitted with cases and shelves. The ends of the other casemates were closed with wooden walls, and the embrasures with windows. They were then cleaned, whitewashed, and fitted with skids for the storage of torpedo cases and anchors.

During the year there were received and stored in these casemates various electrical instruments, supplies, and torpedo material from the Engineer Depot at Willets Point, New York Harbor, and also buoyant mines, transferred from Charleston, S. C., by Capt. F. V. Abbot, Corps of Engineers.

Money statement.

July 1, 1897, balance unexpended	$4,493.78
June 30, 1898, amount expended during fiscal year	3,651.58
July 1, 1898, balance unexpended	842.20
July 1, 1898, outstanding liabilities	10.65
July 1, 1898, balance available	831.55

Torpedo defense, Mobile, Ala.—An allotment of $1,000 was made by letter of Chief of Engineers from appropriation for "National Defense," act of March 9, 1898, for the torpedo defense of Mobile, Ala. With the funds thus allotted, and the assistance of a detachment of engineer soldiers, consisting of one sergeant and six privates, detailed for the purpose, the entrance to Mobile Bay has been mined as far as the material available permitted. Dynamite was purchased, cables and junction boxes put in position, and the mines loaded and planted. A search light with 30-inch projector, complete with generating plant, was received from the Engineer Depot at Willets Point, N. Y., the generating plant installed, and the light put in position on the parapet.

For use in connection with the improved system of operating the mines a rotary transformer, an oil engine, a power switch board, a 40-cell storage battery, and two cable boxes were received from the

Engineer Depot, and all installed in the torpedo casemate. There were also received 3½ miles multiple cable, 8 miles single conductor cable, and various other electrical supplies for use in torpedo service.

For firing mines by judgment a base line was selected, and stations prepared at each end of it, and connected with the torpedo casemate by telephone. One station consists of a small house sunk in the sand and concealed by it from all sides except toward the mine field. Both stations are provided with permanent lines of sights leading to the several junction boxes, one sight for each grand group being sufficient at the inner end of the base line, as the observation station is on the line of triple junction boxes. From this inner station the instant a vessel crosses the line of mines can be determined and telephoned to the mining casemate, and from the outer station the location of the crossing point with reference to the several triple groups of mines.

For the care and operation of the torpedo system three electricians have been employed, and one of them is on duty at the casemate at all times, day and night. A patrol boat has also been employed for guiding vessels across the mine fields, and for general guard and patrol duty in connection with the defenses of Mobile.

Money statement.

Amount allotted during fiscal year	$1,000.00
June 30, 1898, amount expended during fiscal year	2,384.38
July 1, 1898, balance unexpended	* —1,384.38

Planting torpedoes.—An allotment was made by letter of Chief of Engineers, dated June 13, 1898, of $10,000 from appropriation "Torpedoes for Harbor Defense, January 1, 1899," for planting torpedoes in Mobile Harbor, Alabama.

Under this allotment search-light plant has been received and fitted up; system of mines maintained; barge with derrick received; repairs to mines begun; tugboat hired for patrolling mine fields, and supplies received in preparation for future operations.

Money statement.

Amount allotted during fiscal year	$10,000.00
June 30, 1898, amount expended during fiscal year	4,191.51
July 1, 1898, balance unexpended	5,808.49
July 1, 1898, outstanding liabilities	555.34
July 1, 1898, balance available	5,253.15

4 Q.

DEFENSES OF NEW ORLEANS, LA., AND SABINE PASS, TEXAS.

Officer in charge, Maj. James B. Quinn, Corps of Engineers; assistants, Lieut. Frederick W. Altstaetter, Corps of Engineers, from December 6, 1897, and Capt. Henry Jervey, Corps of Engineers, from April 15, 1898. Division Engineer, Col. Henry M. Robert, Corps of Engineers.

New Orleans: Preservation and repair of fortifications.—An allotment of $4,000 was made by the Chief of Engineers on June 14, 1897, for the preservation and repair of fortifications.

* Covered by allotment made subsequent to close of fiscal year.

The work done under these allotments consisted in the cutting and burning of grass, weeds, and brush at both forts, as well as the following:

Fort St. Philip: Rebuilding and partially re-siding the ordnance storehouse; repair of houses; repairing and painting ironwork of bridges; repairing roof of magazine inside the main fort; painting the residence of the ordnance sergeant; putting up galvanized gutters on buildings; repairing foot bridges and wharf and cisterns, and overhauling and disinfecting buildings to improve sanitary conditions.

Fort Jackson: Repairing two bridges, one of which was almost in ruins; repairing fences and walks; repairing and resurfacing elevated gallery of main fort, and overhauling, releveling, repainting, and repairing the ordnance sergeant's residence and officers' quarters.

This work was completed in September, 1897.

Letter from the Chief of Engineers, April 5, 1898, directed that a number of old guns be mounted at once at Forts Jackson and St. Philip. For this purpose the sum of $3,500 was allotted from the appropriation for "Preservation and Repair of Fortifications," act of March 3, 1897.

Work was at once commenced, upon receipt of orders, on mounting these old guns, and by May 1, 1898, all had been placed in position, ready for firing.

Money statement.

July 1, 1897, balance unexpended	$4,000.00
Amount allotted during fiscal year	3,500.00
	7,500.00
June 30, 1898, amount expended during fiscal year	7,500.00

Ten-inch and 8-inch batteries.—The accompanying report of Mr. C. A. Miner, United States assistant engineer, gives in detail much that is interesting, particularly as to the experiments made with a view to determining the resisting power of the piling used.

REPORT OF MR. C. A. MINER, ASSISTANT ENGINEER.

Ten-inch battery.—At the close of the fiscal year 1896-97 the foundation, the mass of concrete superstructure, and most of the earthwork had been constructed, and the ironwork partly erected. The flooring and surface finishing of the magazines and passages remained to be done, the gun platforms were only partially built, and they had settled out of level so badly as to necessitate much cutting away, resurfacing, rebuilding, and rethreading of anchor bolts. The doors remained to be made and hung.

The money previously appropriated for this work was so nearly exhausted that little was done during the first month of the present fiscal year.

A further allotment of $6,000 was made by letter from the Chief of Engineers, July 10, 1897. With this money the above defects and imperfections have all been remedied, the gun platforms completed, the magazines completed, the drainage system constructed, and the battery completed in all its details.

The magazines of the north emplacement leaked so badly during and for several hours after each heavy rain that an attempt was made to ascertain the cause and to remedy it.

When this emplacement was commenced the depth of the concrete was designed to be much greater than the subsequent plans, in accordance with which the emplacement was completed, required. The concrete work was built up about one-half its height when the plans were changed. Consequently there is a shelf of concrete extending forward underneath the earthwork of this emplacement. It was believed that water flowed off from the concrete parapets and seeped through the earth till it reached this shelf, where it piled up and was forced to seep horizontally through the concrete, thereby causing leakage in the magazines. To remedy this a trench was excavated in the earth parapet down to the concrete, a tile drain carefully laid having an outlet at one end through the parapet on the front face, and at the other through the end of the parapet. The vertical surface of the concrete was also given a smooth finish with a coat of cement mortar and then two coats of mixture of one

part asphalt and three of coal tar, applied hot with a brush. Practically no leakage has been discovered since. This work was completed on October 2, 1897.

A brick drain and a concrete walk were built in the rear of the battery, the latter being, with the exception of a slight slope to the rear, a continuation of the floors of galleries and magazines. The walk was designed to greatly facilitate ready communication between the two emplacements, but the subsequent erection of boiler, engine, and dynamo for electric plant in the immediate rear of the traverse has intercepted this freedom of communication and has necessitated the destroying of walk and the main drain at this place. The drain had its outfall in the moat between the 10-inch battery and the new 8-inch battery. This work was commenced October 18 and completed October 30, 1897.

The unequal settlement in the battery had thrown the gun platforms entirely out of level. It was designed to load these platforms with old shot, so as to bring them to firm bearing and, if possible, check the unequal settlement. About 240 tons of old projectiles on hand were transferred and placed upon the platforms around the counterweight wells in May, 1897, a special appropriation of $3,000 having been made from previous allotment for this work. On July 14 they were moved into shot rooms in the rear part of the platforms, where settlement was taking place the most slowly. Here they remained until April, 1898, when they were removed and piled in the rear of the battery.

The effect of settlement, relative and absolute, and of loading the platforms can be seen by studying the drawing herewith appended, showing curves of subsidence, whereon are shown graphically the rate of settlement of a number of points. They are in three groups, for the convenience of comparison of the two emplacements and of the gun platforms. These curves indicate that there has been an almost imperceptible decrease in the rate of settlement for the past year.

The guns were delivered on July 7 and the carriages September 16 and 23, 1897, respectively. The work of setting base rings and mounting guns was commenced on January 31 and was completed March 5, 1898. Considerable work was done cleaning, removing rust, painting and oiling of guns and carriages at different times during the year, mostly in December and January, to preserve them from deteriorating under the influence of the elements.

The base rings were not cemented into place till the gun mountings had rested in their position for several weeks, and had to be releveled when they finally were permanently set, in April, 1898. At the same time the surfacing of the platform around the base rings and inside the circular steps, the cutting through of drains and setting of grates to drain the water into the counterweight well was done. Excepting a few details, the concrete work was entirely finished by April 30. The electric lighting remained to be done. This was also completed by June 1, and all other details were finished, so that the battery was turned over to the artillery June 7.

Eight-inch battery.—In April, 1897, Lieutenant Riché, the Engineer Officer in charge of the defense works for the Lower Mississippi at that time, was ordered to submit plans and estimates for a third emplacement for 10-inch disappearing gun. Before these were submitted The Board of Engineers, observing the unusual amount of settlement of the 10-inch battery under construction, had come to the conclusion that 10-inch guns were inadvisable in this location, and changed the project to a battery for two 8-inch guns.

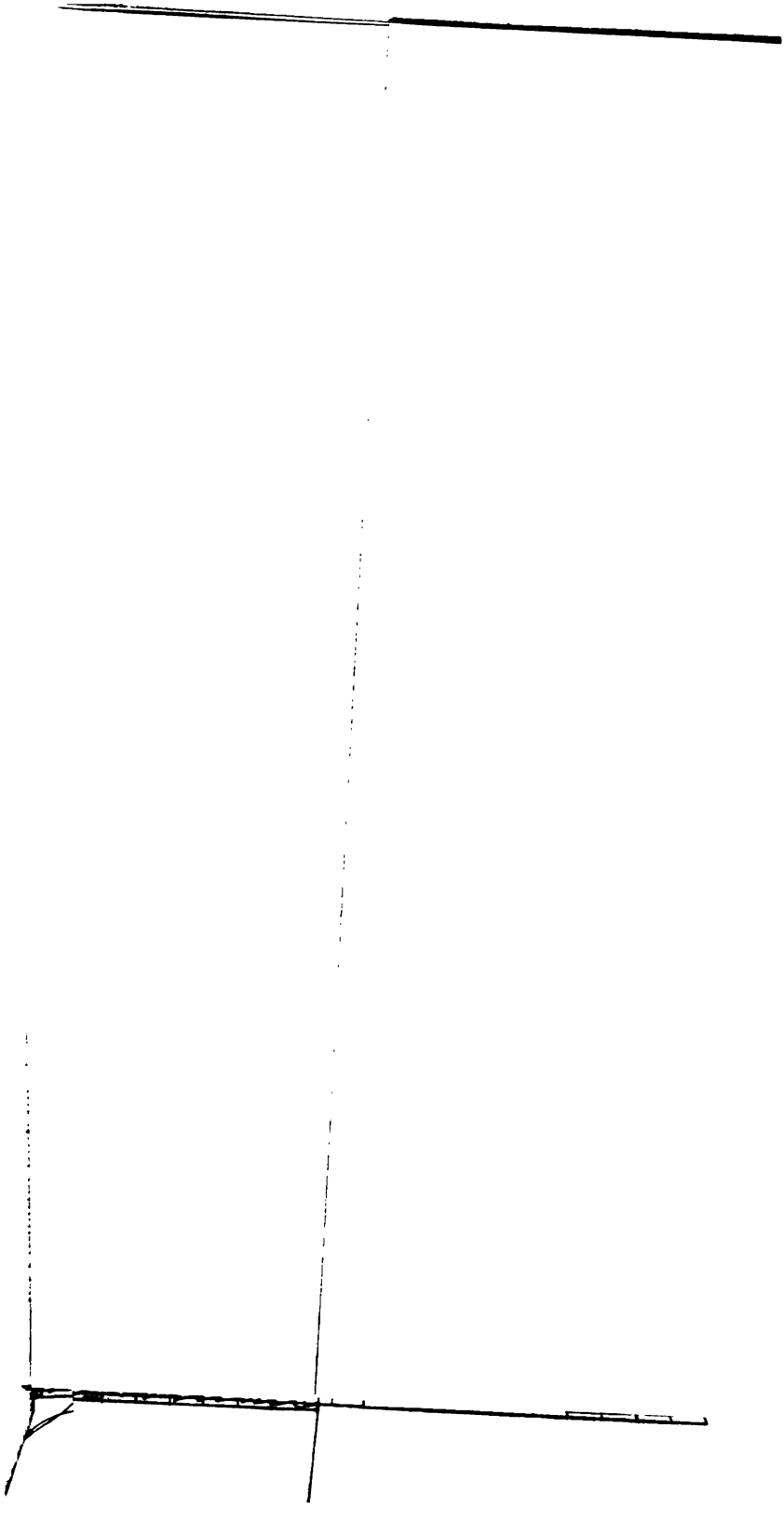
Plans and estimates were submitted to the Chief of Engineers August 10, 1897, were approved by him, and an allotment of $90,500, out of the appropriation for "Gun and Mortar Batteries," act of March 3, 1897, made on August 25, 1897. Bids were at once invited and contracts entered into for furnishing and delivering the necessary materials for construction.

It was hoped that materials would be delivered promptly, so that construction could begin in September. Yellow fever broke out early in September and the resulting quarantine greatly hampered and delayed the contractors in making delivery of materials. It was not deemed prudent to commence work till quarantine should be raised, partly on account of the lack of materials necessary to prosecute work, and partly on account of the inability to obtain labor or the danger of importing fever-infected labor.

Clearing of site was commenced with a few laborers on October 25, and after the fever subsided was carried on with great rapidity. This work consisted in demolishing old gun platforms, magazines, foundation of wood and concrete, leveling old parapets, dismounting old guns, etc. It was completed on December 18, 1897.

Pile driving was commenced on December 27, 1897. The sheet piling, 540 in number, were all driven by January 10, and the driving of the round piles, 800 in number, was done between the dates of January 10 and February 10. The foundation, including grillage, was entirely completed by March 23.

Concrete forms were at once built as far as possible. At this stage there was a delay of about ten days in commencing concrete work, due to the fact that cement



contractors were behind in making delivery. Concrete work finally began on April 6, and proceeded without interruption. It was completed, except the exposed surfaces, with a coat of rich mortar on May 1. The concrete forms were removed on May 2, and the rest of the fiscal year was devoted to placing the trolley beams and other ironwork, finishing concrete surface, making and setting of doors, and putting up the earthwork of battery. The first of these was completed, including painting, by June 10. The others were completed about the same time—June 30—except the earthwork.

Until January 1 work was conducted with one eight-hour shift of men per day; from that date until April 1 in two eight-hour shifts, working, respectively, from 4.35 a. m. till 1 p. m., with twenty-five minutes' time at 7 a. m. for breakfast; and from 1 p. m. till 9.25 p. m., with twenty-five minutes at 6 p. m. for supper. From April 1 till May 15 work was conducted in two eleven-hour shifts, changing watch at 6 o'clock, morning and evening, and having one hour off at noon and midnight. On the latter date we returned to the eight-hour shift system and continued thus till the close of the fiscal year, with the exception of the interval between June 1 and June 24, during which work was done with only one eight-hour shift on account of the high water in the river, which flooded the barrow pits where earth was to be obtained for the parapets.

Immediately after the approval of plans bids were invited for the necessary materials and contracts let.

Formal contracts were entered into as follows:

Salemen Brick and Lumber Company, Limited, Slidell, La.: Round piles 58 feet long; sheet piles 8 inches by 12 inches by 40 feet; strips for tongue and groove of sheet piles.

W. W. Carré & Co., New Orleans, La.: Grillage timber 12 inches by 12 inches, sawed.

Irwin Jamison, New Orleans, La.: Portland and natural cement.

H. S. Karstendiek, New Orleans, La.: Sand and gravel.

The working plant on hand to commence with consisted of one pile driver and steam hammer, one 16-horsepower and one 30-horsepower Lidgerwood hoisting engine, one 60-foot boom derrick, buildings, quarters, bridges, wharf, concrete mixer, dump cars, cisterns, messing plant for laborers, blacksmith outfit, etc. It was not thought necessary to increase the plant to any great extent. Another 60-foot horizontal boom derrick was purchased and erected; a steam pump was purchased, a reservoir erected in an elevated position, steam was piped from one of the hoisting engines, and a complete water-supply system established, the water being obtained from the river and piped to the mess hall, quarters, concrete mixer, engines, and other places.

Experience has proven that this was a splendid investment. It has saved several times the original cost in labor, for previously all water had been pumped by hand, and even then was very inadequate to the needs. The main addition made to the working plant beyond this consisted in the purchase of shovels, rope, blocks, wheelbarrows and other small tools, and articles needed for repairs. The quarters for employees were also increased by the erection of three more buildings, 32 by 50 feet, at the time when our national relations became strained, and when the quartermaster's building, previously used by the Engineer Department, had to be given up and the number of laborers greatly increased.

This battery differed from the 10-inch battery in the following essential respects, so far as its applicability to this earth formation is concerned: In the 10-inch battery the concrete work of each of the two emplacements and the two gun platforms were made as detached masses, four separate monoliths, besides having in each definite planes of weakness. Each of these monoliths were placed upon a separate foundation, entirely detached from the others. As concrete masses joined one another, and as it was designed to have foundations that covered a larger area than the concrete superstructure resting upon it, it followed that each monolith rested on one side of the foundation supporting it. This was true with one exception, viz, the south emplacement, not including the gun platform, was built upon a foundation of piles and without a wooden platform, and the foundation for this extended only underneath the concrete, leaving the superstructure symmetrically disposed on its foundation. In the 8-inch battery it was designed to build the entire concrete work of the battery symmetrically as a single monolith, resting symmetrically on a single foundation, the center of gravity of the superstructure coinciding with the center of bearing of the foundations.

This foundation was surrounded by sheet piling driven first, so that the subsequent driving would compress the inclosed earth to its limit. The grillage was made much stronger and stiffer than in the 10-inch battery, and the foundations covered a larger area per unit of concrete in the superstructure. It was hoped that by making these improvements a much better foundation could be made for the 8-inch battery than that for the 10-inch battery, and that even if the battery should settle it would

settle uniformly, thereby not impairing its usefulness. The area covered by the foundations is 15,200 square feet, the weight of the concrete resting on it 8,360 tons, that of earth 7,900 tons, that of the gun mountings about 140 tons, making a total weight on the foundations of 18,000 tons, or 1.18 tons per square foot. I believe the actual weight will at times be somewhat greater than this, for the following reasons: The earth parapets extend beyond the area of the foundation on all sides, and settlement taking place underneath more freely beyond the grillage, that part of the superstructure resting upon the foundations will not be a cylinder with vertical surface, but an inverted conoid, a section of which is defined by the foundation and the slope of which is variable, but has for its maximum the angle of repose of earth.

The piles were all driven with one Vulcan steam hammer weighing 8,800 pounds, the striking part weighing about one-half this amount and the frame and steam chest about one-half, which acts as a dead weight on the pile. Stroke, 40 inches. The driving of the round piles commenced after the sheet piles were all driven. They were driven in rows lengthwise of the battery, commencing with the center rows and proceeding toward the sides. Before driving commenced posts had been driven to the surface of the ground over the whole area of the foundations, and their levels carefully taken. Their levels were taken at various times, as the pile driving progressed, to ascertain the heaving of the ground. After the pile driving had been completed these levels showed that there had been very little heaving in the middle, where the first rows were driven, but that it increased toward the sides, where the heaving amounted to as much as 2 feet. This would indicate that, as might have been expected, the compression of the earth did not take place uniformly. The piles first driven evidently formed their own barrier to the lateral movement of the earth, so that this area was not influenced by the compression of the earth due to the subsequent driving. I believe a greater uniformity of bearing would be obtained by driving every alternate row of piles first, then the rest. I believe, too, that when any considerable amount of heaving takes place due to pile driving, the bearing power of the compressed earth is lessened in consequence, and that the best efforts in pile driving are obtained when compression of earth is carried just to the point of heaving.

The foundation was constructed by—

(1) Driving a row of 8-inch by 12-inch sheet piling, 25 to 40 feet long, made with tongues and grooves by nailing strips on the edges, inclosing the entire area of the foundations.

(2) Driving round piles, 58 feet long, within this area in rows, lengthwise of the battery, 4 feet apart centers.

(3) Constructing a grillage consisting of a row of caps, lengthwise the battery, resting on this a close layer of timbers in a traverse direction, and on the latter a close layer placed longitudinally, all these timbers being 12 by 12 inch sawed pine and each layer securely driftbolted to the foundation below. The driftbolts used were all round and pointed, 1 inch by 30 inches being used for securing the caps, and ¾-inch by 22 inches for securing the upper layers. The upper surface of this grillage was established at 12 feet below mean Gulf level. Borings were made and samples preserved to the depth of 100 feet.

From this source it is learned that below the surface stratum of vegetable matter, of about 5 feet depth, the foundation is mud, consisting of a mixture of sand and clay nearly uniform in composition till a depth of 26 feet is reached. Then comes a stratum of 3 to 6 feet thickness of pure, fine, compact sand, evidently an old river batture, judging from its tilting position, variable depth, and composition. Below this for several feet the composition is much the same as above it, though somewhat more compact; but after a depth of 40 to 45 feet was reached the percentage of clay gradually increased till at a depth of 65 to 75 feet stiff, heavy, and almost pure clay formation was found.

The sand stratum has always offered great resistance to the penetration of piles, so much so that it was thought at one time to be a safe place to stop with piles. Accordingly the pile foundation for the south emplacement of the 10-inch battery was driven until the pile points terminated in this stratum. Subsequent settlement was so great as to discourage placing further dependence upon it. Doubtless the entire sand stratum underneath that emplacement has settled. Considerable testing for bearing power of the piles in this soil was done. The results are shown graphically, on an accompanying sheet, where curves showing the resistance offered by piles in driving are shown. On these diagrams the depth of the piles below the surface is laid off on a vertical line, downward. From this line as a base horizontal ordinates are laid off, each representing the number of strokes of the steam hammer required at that point to drive the pile 1 foot. The curve through those points is the curve of resistance of that pile. The energy developed in each stroke of the steam hammer is the same, hence the ordinates and the curves represent energy *expended* as well as blows struck. It would not be true to say that these curves *also* represent the work done in driving the pile, for a very considerable part of the

energy expended in the steam hammer was lost on account of soft or battered pile heads, elasticity of the wood fibers, and crooks in the piles, which deflected much of the downward energy.

So far as possible piles were selected for testing which were straight, of sound heart, uniform in taper, and medium size, so that the lost energy would be minimum, and so that the uniformity of the curves would admit of definite conclusions concerning the bearing power of the earth at this point. Thus far the testing had been made with practically no expense, observation having been taken during the regular course of pile driving for battery. Some further testing was made, however, in the following manner: After the piles were all driven for the foundation, four piles were driven within this area by means of a drop hammer. They occupied the four corners of a 7-foot square. They were of different lengths, but were all hewn straight, and to uniform shape and size. Their dimensions were 8 inches by 8 inches, and were tapered for 16 feet of their length evenly down to 4 inches by 4 inches at the point. After driving and sawing off to the same level a platform and box was built upon them in such a way as to have no vertical rigidity, i. e., so that that pile would be free to settle under a load without the load thereby being distributed to the other piles. The platform was then loaded with old shot, and at short intervals levels were taken. Each pile supported one-fourth the entire weight. As soon as any pile showed sign of settlement, however small, the platform at that corner was blocked up to prevent further settlement and the weighting continued. Records were kept of the tonnage required to produce settlement of each pile. When this was completed, four more piles of the same lengths and dimensions were driven about 40 feet beyond the limits of the foundation and weighted similarly.

The following table gives the results of these tests. The columns of "load" give the load in tons under which the piles showed signs of settlement. The column of "surface" gives the surface of each pile in contact with the earth. The columns of "unit of friction" give the quotient of total load on any pile divided by the surface in contact with earth, or the resistance to settlement per square foot surface of the pile.

Length.	Surface.	Piles driven inside of foundation.		Piles driven outside of foundation.	
		Load.	Unit of friction.	Load.	Unit of friction.
Feet.	*Sq. feet.*				
16	32	6.53	0.204	7.07	0.221
22	48	8.69	.181	11.27	.235
28	64	13.50	.211	16.21	.253
34	80	.....	.....	19.00	.238

The 34-foot pile inside the foundation struck some local obstruction just before driving ceased, and did not show signs of settlement when weighted with 27 tons.

Curves of resistance to driving were made for one pile outside the foundation and one inside. As the energy expended in different blows of the drop hammer is not constant, the resistance curves are curves of expended energy only, the ordinates representing energy expended in the same ratio as they do for the piles driven with steam hammer, so that results of the two methods of driving may be compared. The drop hammer used weighs 1,200 pounds. The load upon these test piles was applied rather slowly, usually not more rapidly than 8 tons per pile per day. On two occasions, at least, the weight nearly approached that which produced settlement, which was allowed to stand forty hours on the pile without having any perceptible effect. The loading was not done till the pile had been driven from one to two weeks, giving time enough for the pile to attain its full bearing power.

These results would indicate that dependence can be placed upon an ultimate frictional resistance against settlement of piles of 0.2 ton per square foot of surface, and that this value increases but slowly at increasing depth. This being true, 58-foot piles that have nearly 200 square feet of surface might be depended upon to sustain a load of 40 tons, and the 30-foot piles used in the south emplacement of the 10-inch battery, having 90 square feet surface, 18 tons.

These are the values that it would seem might be relied upon for piles driven individually, or when driven so far apart that each pile in settling would do so by the friction of the earth on the surface of the piles having been overcome. If piles are driven in compressible soils too closely the full frictional effect will not be obtained and the piles will settle collectively when overloaded by the entire mass of piled earth having gone down before the limit of frictional resistance is reached. And all such excess of piles within a given area beyond the number which would settle individually without carrying down with it the earth strata when overloaded is worthless as affording any additional bearing power to the foundation. Whenever pile foundations in compressible soils have been observed to have settled before a weight

has been applied as great as the frictional resistance of the earth on the pile surfaces, which may be ascertained by the simple process of weighting a few test piles, it shows that there is an excess of piles within the given area of foundations. Better foundations could have been built by distributing the same number of piles over a greater area, or by driving a fewer number of longer piles.

The superstructure of the 10-inch battery constitutes a load of 15 tons per pile in each emplacement, or 85 per cent of what our experiments on the surface frictional-bearing power of piles would indicate that the 30-foot piles would bear, and only 37 per cent of what the long piles ought to bear. Yet both emplacements have settled, the north emplacement, where the long piles were used, about 0.5 foot, the south emplacement, where 30-foot piles were used, from 1 to 2 feet, and very unevenly. Likewise in the 8-inch battery the load (18,000 tons) on the foundations produces a frictional resistance of 0.094 ton per square foot of frictional surface of piles—less than half what our experiments indicated that the piles would bear. Yet this battery has also settled. In my last year's annual report on 10-inch battery I recommended a spacing of 7 feet for piles. I am confident that had the spacing been greater by one-half on the 8-inch battery the bearing power of the foundation piles of the same length would not have been decreased, and it might have been materially increased by splicing piles and making them longer.

It was hoped that in making these experiments sufficient data could be obtained so that some of the constants in the reputable formulæ for bearing power of piles could be eliminated, and the value of others found for this locality; or that the reliability and applicability of the formulæ to conditions existing at this place might be ascertained; or that in case of their failure a new formation found here. The outbreak of war put an untimely end to these experiments, but it is hoped that they may be continued in the near future.

The excavating and sawing of pile heads was accomplished in eight days, and the capping of piles and construction of grillage, constituting the placing of 420,000 feet B. M. 12 by 12 timber, required only ten days of two eight-hour shifts each. All this timber was transferred to the work over barrow pits, moats, piles of material, and obstructions of all kinds, and thence delivered to the exact place in the grillage where it is to be used by overhead trolleys. It was erected on the same plan as the Lidgerwood cable ways, only much simpler. A manila rope was suspended at the height of 35 to 40 feet, being drawn taut between two gin poles well guyed. A snatch block rides along this cable. Attached to this snatch block is a rope which runs to one gin pole, and thence to one drum of a hoisting engine, thus serving as a backing line. To the trolley was also attached another snatch block, through which runs the hoisting line with a pair of timber hooks attached to the end, the other end running to the second gin pole, and thence to the second drum of the hoisting engine. A rig like this could bring and place timber as rapidly as two forces of men, forty each, could place, fit, and driftbolt them into position. Round driftbolts were used entirely. For capping they were 1 inch by 30 inches, pointed, and the holes were bored with $\frac{7}{8}$-inch augers. For the rest of the grillage they were $\frac{3}{4}$ inch by 22 inches, the holes being bored with $\frac{11}{16}$-inch augers, 4 feet apart.

Considerable weight and concrete were saved by placing relieving arches in the lower part of the battery. The forms were built mostly of 1-inch lumber, and were left in. They have been made use of for still another purpose. These arches have all been connected together with culverts built before concrete work was commenced, at an elevation of 2 feet above mean Gulf level. A main drain runs from one of these to the rear. The counterweight well, magazines, and passages have drain holes from their floors into these arches. Thus they are made to serve the purpose of a complete system of underground drainage for the battery.

The concrete mass was placed in twenty-six days. It was mixed by machine after the same general method as in the 10-inch battery, described in detail in my last year's annual report. The main difference was that in the 10-inch battery German Portland cement was used entirely, while in the 8-inch battery American natural cement was used for the entire mass, the surfacing of the exposed faces of battery and of the surfaces and floors of magazines and gun platforms having been done with American Portland cement. The natural cement was a Louisville Star brand, 6,000 barrels having been used. The Portland was Atlas brand, 200 barrels; Vulture, 100 barrels, and Knight, 200 barrels. Having no testing machine, we were unable to make any tests of cement that were reliable or satisfactory. It was feared that the natural cement was valueless, for, after taking on a slight initial set, it remained in a waxy state for days without apparently hardening in the least. I noticed, however, that exposure to the air hastened the hardening, consequently the forms were taken down as soon as seemed prudent, really on the day following the completion of the concrete mass. The forms for magazines were left about a week longer. When the forms were taken down the concrete was in a soft, viscous state, but a few weeks' exposure to the air developed a hard set on the surface.

These results convinced me that natural cement, especially the Louisville brands, *should not* be used where the strains are to be applied within a few weeks. A con-

siderable quantity, about 500 cubic yards, of old concrete, which had been blasted out of old foundation in clearing site for new battery, was used the same as rock, embedding large pieces in the new concrete. The mass of concrete had the following composition, approximately: Natural cement, 1 part; sand, 1¾ parts; gravel, 4 parts. It was made somewhat richer than this in the gun platforms and the tops of the battery for a depth of 1 foot. On all exposed surfaces, in the magazines and the interior of the battery, there was a thickness of 3 inches composed of mortar and sand of 2 parts and cement 1 part, and immediately in front of the guns the thickness was increased to 6 inches.

Unusual precautions were taken against dampness that might affect the magazines. At an elevation of 6 feet there is a tile drain which surrounds the concrete entirely on the river front or sides, and has an outfall at the ends to the rear, having been given a slope of 0.5 foot. In front of the magazines the vertical surfaces were given a coating consisting of asphaltum 1 part, coal tar 3 parts, applied hot with a brush. In addition to this there was placed within the walls surrounding the magazines, and at a distance therefrom of 1 foot, a ventilating partition built of hollow tile. The ventilator is open to the air at the upper part, and extends from 1 foot above the level of the ceilings of the magazines to the floor level, and have their drainage into the relieving arches underneath.

The entire exposed surfaces of the concrete—floors, walls, and magazines included—have been given a smoothing coat of mortar composed of Portland cement 1 part and of sand 1 part.

The gun carriages and mountings and one gun were delivered February 26. They were moved across the battery from the front and mounted when the parapets had been constructed, just to the height of the gun platform, in April, which proved much quicker and more economical than doing it after the parapets had been completed. One of the guns did not arrive till June 2. The mounting of it was completed June 15. The mounting of both these guns was done by the Engineer Department. The base rings have not yet been permanently leveled and set in place, it being thought best to leave them as long as possible, till the result of settlement of the battery could be observed.

At the end of the fiscal year the battery was still uncompleted in the following respects: About 1,000 cubic yards of earth was still to be placed in the parapets, but before this can be done the two buildings used for storehouses will have to be removed. The circular steps and surfaces of gun platforms are yet to be given a smoothing surface coat of mortar, and the base rings permanently set in concrete. The concrete veneering, 1 foot thick, over the entire surface of the loading platform, remains to be done. It is not thought advisable to do this till several month's time has elapsed, so that the earth shall have had sufficient time to settle. A temporary platform has been constructed of wood, to facilitate drill and the use of the gun for the present. Except this, the battery could easily be completed by July 15, if the money were available.

The original estimate for material and cost of construction of this battery was as follows:

Repair, alteration, and extension to working plant	$3,000.00	
Preparation of site, demolishing of old magazines, gun platforms, parapets and parade to water battery, consisting of earth, concrete, wood foundations, and shells in unknown portions, 7,200 yards, at average unit price of 65 cents per yard	4,680.00	
Foundations:		
22,000 linear feet of 12 by 12 sheet piling in place, at 25 cents	5,500.00	
63,600 linear feet round piling in place, at 20 cents	12,720.00	
418,000 feet B. M. of 12 by 12 timber, in grillage, at 25 cents	10,450.00	
20,500 pounds driftbolts, at 5 cents	1,025.00	
Refill below grillage, 1,130 yards earth, at 45 cents	508.50	
		$37,883.50
Additional 10 per cent for contingencies		3,788.35
Cost of battery up to superstructure		41,671.85
Superstructure up to reference (12):		
Placing 2,420 yards concrete, at $8.50, including forms	$20,570.00	
Placing 8,000 yards earth in parapets and gun platforms, at 50 cents	4,000.00	
4,000 pounds anchor bolts and iron in place, at 10 cents	400.00	
		24,970.00
Additional 10 per cent for contingencies		2,497.00
		27,467.00

Superstructure above reference (12):		
Placing 1,744 yards concrete, at $8.50, including forms	$14,824.00	
Placing 4,000 yards earth in parapets, at 50 cents	2,000.00	
Placing 24,000 pounds iron in ceilings, and other places, at 5 cents	1,200.00	
Sixteen triplex spur-gear blocks	576.00	
Drainage system, ventilators, asphaltum, etc	2,500.00	
Doors and fittings	500.00	
Setting base rings	800.00	
		$22,400.00
Additional 10 per cent for contingencies		2,240.00
Cost of superstructure above reference 12		24,640.00
Grand total, cost of entire battery		93,778.85

This was the estimate made on the supposition that the battery was to be built under normal conditions, and had not unusual conditions developed, such as could not have been foreseen, the battery would have been built within this estimate. By accident in copying, by which the estimate for extension of plant was omitted, the estimate as given to the Chief of Engineers appeared about $3,300 less than this.

The following unforeseen circumstances have tended to increase the cost beyond what was anticipated: The outbreak of yellow fever and establishment of quarantine in the autumn of 1897; the outbreak of war with Spain, and the unusual long period of high water in the Mississippi River, which has prevented obtaining earth except by very long haul. The battery has already cost $97,000, and it is estimated that $3,000 more will be required to complete it.

Money statement.

July 1, 1897, balance unexpended		$2,830.30
Amount allotted during fiscal year		106,282.56
		109,112.86
June 30, 1898, amount expended during fiscal year		97,085.62
July 1, 1898, balance unexpended		12,027.24
July 1, 1898, outstanding liabilities	$5,394.79	
July 1, 1898, amount covered by uncompleted contracts	1,200.00	
		6,594.79
July 1, 1898, balance available		5,432.45

Battery for two 4.7-inch R. F. guns.—The approved project for this battery provides for the construction of batteries of two 4 7-inch rapid-fire guns, pedestal mounted.

A preliminary allotment was made of $6,000 for the construction of this battery, and a further allotment of $1,000 was also made, both from appropriation for "National Defense," act of March 9, 1898.

Under instructions to make such arrangements as were possible for the mounting of these guns at the earliest practicable date, in the absence of plans for the 4.7-inch battery plans and estimates were made and submitted modeled from the 5-inch rapid-fire guns. On April 14, 1898, these plans and estimates were returned by the Chief of Engineers, with the statement that they would involve too heavy expense and loss of time, and directing that these guns be mounted temporarily on the face cover, using the existing magazines and parapets. By direction the surplus material already purchased for this battery was used in other work at the forts as far as practicable. The procurement of supplies and engagement of services was authorized under item 1, Army Regulation 556.

No further work has been done toward mounting these guns on account of the nonarrival of guns and carriages, but it is proposed to mount them on an existing platform.

Eight-inch B. L. rifles mounted on 15-inch smooth-bore carriages.—The project for this battery proposed the mounting of two 8-inch B. L.

rifles on strengthened barbette carriages for 15-inch smooth-bore guns by using steel cradles.

An allotment of $6,000 was made for this battery on April 27, 1898, and a further allotment of $4,000 was made on June 13, 1898, both from the appropriation for "National Defense," act of March 9, 1898.

Material has been ordered for the construction of this battery and plans and estimates of same submitted. The present intention is to strengthen and use the existing old platforms.

The iron for converting the carriages was received on May 20, 1898, but nothing has been done toward mounting the guns, as the guns have not arrived, and it is considered inexpedient to weaken the armament of the forts by dismounting the 15-inch Rodman guns now mounted on the carriages proposed for conversion, until the 8-inch rifles have arrived.

Money statement.

BATTERIES FOR RAPID-FIRE GUNS AND 8-INCH RIFLES.

Amount allotted during fiscal year	$17,000.00
June 30, 1898, amount expended during fiscal year	8,374.25
July 1, 1898, balance unexpended	8,625.75
July 1, 1898, outstanding liabilities	604.95
July 1, 1898, balance available	8,020.80

Emplacements for two 8-inch rifles, disappearing carriages.—Mr. C. A. Miner's report is appended, and it will give in detail much that will prove interesting.

REPORT OF MR. C. A. MINER, ASSISTANT ENGINEER.

Orders were received on March 18, 1898, to commence construction of a battery for two 8-inch B. L. rifles with funds allotted from the appropriation for "National Defense," act of March 9, 1898, and the work of making estimates for the necessary materials for construction work and for working plant was done without delay. These materials were mostly purchased by informal contract in open market, and delivery commenced before April 1.

The location of this battery was such that the transportation of all materials to the site was necessarily expensive, and as the greatest attainable speed in construction was enjoined it was necessary to provide a very elaborate working plant. As this occurred during the period of high water in the Mississippi River, when all the land outside the levee was submerged and all inside the levee which was not barrow pits or moats was wet with seepage, it necessitated the construction of wharves large enough to not only unload materials, but to store them to some extent. The bank of the river opposite the battery being very steep and caving from year to year, it was deemed unsafe to build wharves at this point on which large quantities of materials would have to be stored. Hence the wharf had to be constructed much lower down, below the limit of caving bank. All materials had to be brought over parapets 25 feet high. There was storage space in the old casemates near the proposed battery for cement, and limited space on the parade in the rear of the battery for sand, gravel, and lumber. The casemates would also serve to some extent as quarters for laborers.

These were some of the conditions confronting the engineers; some of the elements in the problem of designing a proper working plant. It was decided to construct a wharf 80 by 100 feet, and thence an elevated railroad pile trestle on a compound curve up a 2 per cent grade to the rear of the battery. A derrick was to be placed on the wharf to hoist materials from barges and place them on cars. Materials were to be hauled on dump cars by a steam locomotive. A derrick was to be erected near the rear terminus of the trestle road to assist in unloading certain kinds of articles. A derrick was to be erected near where the trestle road crossed the front parapet, for the same purpose, and also to hoist piling and timber from moat and place it inside the fort. When concreting should begin two derricks and a concreted mixer were to be erected in convenient places to handle the concrete.

Lumber commenced to arrive March 26, and construction work commenced the same day. The first work done was to build a temporary bridge from the outer to

the inner or main levee, and thence a temporary bridge across the moat to the nearest bastion. In this bastion was immediately constructed a mess hall. This was accomplished so rapidly that the boarding of employees commenced April 6. Following this, an office was built near the ordnance-sergeant's residence. A building in the rear part of the fort outside the main walls was constructed for quarters for employees, and buildings were constructed for blacksmith and carpenter shops. The wharf and trestle bridge were constructed as quickly as possible, three pile drivers were built, the derricks erected, and the working plant completed as far as practicable at this stage of the work, with all possible speed. We were ready to commence work on the foundations two weeks before the necessary piles were delivered, and a large part of the force of laborers had to be discharged for want of work to do.

The wharf is built upon piles driven 8 feet apart, and usually with 30 feet penetration. There are 143 piles in all. The trestle bridge is built of similar piles in three-pile bents, 10 feet apart up to the parapets. Beyond that they are framed bents resting on the ground. It was intended for standard-gauge rolling stock. A standard-gauge engine and 8 narrow-gauge dump cars were purchased, necessitating the putting in of a third rail.

Two 16-horsepower American, one 30-horsepower Lidgerwood, and one old 35-horsepower Mundy engine were purchased. Also one 60-foot boom, 58-foot mast, and 5-ton capacity derrick of the horizontal boom type was purchased of the American Hoist and Derrick Company. A water-supply plant was erected.

The cost of working the plant, in detail, is as follows:

Wharf and trestle bridge (estimated)	$7,200.00
Two pile-driver derricks	900.00
Ten Kitson lights	525.00
Two 16-ton hoisting engines	1,850.00
One 30-ton hoisting engine	984.00
One 35-ton hoisting engine	700.00
One locomotive	600.00
Eight dump cars	865.00
One 5-ton derrick	730.00
One 6,500 pounds steam pile-driver hammer	745.00
One 2,800 pounds drop hammer	69.43
Buildings and bridges (estimated)	
Mess-hall plant (estimated)	1,200.00
Blacksmith plant	120.00
Sundries	2,000.00

Two 5-ton derricks, the concrete mixer, and one 8,800 pounds steam pile-driver hammer used on this work were taken from the work on other emplacements.

Piling for foundations began to arrive slowly April 14. Driving at once commenced, but was continually interrupted on account of the slow delivery of piles. Supplementary work was found for the labor to some extent in the moving and remounting of old 15-inch Rodman guns and carriages, for which a special allotment of $6,000 was made April 27.

At the commencement of work great difficulty was experienced with the labor. Most of the laborers were from New Orleans and were of a very poor class. Many had no motive in coming but to satisfy a curiosity to see the forts, and had no intention of performing labor that should prove difficult or distasteful to their refined senses. They could not be depended upon in the least, and out of such a heterogeneous class it required some time to cull out the few good men and organize a working force. About 1,500 men had to be employed before a working force of 400 good men was organized. Those discharged flooded the office in New Orleans, clamoring for the immediate payment of their small time checks, and stampeded all office work.

Finally, however, a splendid working force was organized and real progress began to be made. It was decided to introduce negro labor to some extent, with the hope partly of obtaining a more reliable and earnest class of labor, and partly that the negroes would be more immune to the very unhealthy climatic conditions existing at the site of the work. About 150 negroes arrived in the first installment, and their arrival was the signal for a general strike by all the white laborers. This occurred May 12.

At this time pile driving was nearly completed, lacking not more than three days. The negro labor that supplanted the white were totally unskilled, especially at pile driving, and the first two or three installments were of about as worthless a class. Having to commence anew to build up an organization and get it into working discipline, there was almost no work accomplished for two weeks, and the completion of the battery was delayed that much. It required nearly three weeks for the negroes to complete pile driving, and it was only accomplished in that time by the introduction of a number of white skilled pile drivers. This was May 27. During the remainder of the fiscal year the labor consisted of both whites and *blacks*, the whites being depended upon generally where skill was required. When

the white pile drivers were first introduced there was a strike of limited proportions among the negroes, which was soon quelled, since which there has been no labor trouble, and whites and blacks have worked together harmoniously.

The foundations were entirely completed June 21. The concrete-mixing plant, derricks, and concrete forms were at once put up and concreting commenced June 28, since which we have been making and placing concrete at the rate of 240 yards per day. It is estimated that the concrete work will have progressed so far that the mounting of the guns could be begun by July 12, and that the concrete work will be finished, except the smoothing surface coat of plaster, by July 20.

The type of battery, foundations, and superstructure is almost identical with the 8-inch battery constructed under the regular fortification appropriation acts.

The materials of all kinds and methods of construction are the same. It was constructed with a more elaborate plant, and, as a rule, at greater speed. It was estimated to cost $127,809.55, nearly $35,000 more than the 8-inch battery previously constructed. This increased cost would be:

(*a*) In purchasing and establishing an adequate working plant.

(*b*) In the increased cost of labor, due to the poor quality of labor obtainable at this season of the year, and the fact that a much larger force had to be kept in reserve than was actually needed most of the time on account of the emergency.

(*c*) In the increased cost of materials, due to the influence of the war, the very limited time allowed the contractors to make a delivery, and the fact that there was not sufficient time to obtain the freest competition in bids.

In driving piles a stratum was reached at a depth of 30 feet which increased rapidly in hardness down to 40 feet depth, below which it was impracticable to drive piles. We succeeded in driving a few deep as 50 feet before destruction of the pile head, but did not penetrate through the hard stratum. Most of the piles, therefore, are driven 40 to 42 feet deep. It is believed that a much better foundation exists for this battery than has been found at the site of the other 8-inch battery, and that no trouble will be experienced from settlement.

Money statement.

Amount allotted during fiscal year		$125,000.00
June 30, 1898, amount expended during fiscal year		92,327.44
July 1, 1898, balance unexpended		32,672 56
July 1, 1898, outstanding liabilities	$18,673.58	
July 1, 1898, amount covered by uncompleted contracts	2,350.00	
		21,023.58
July 1, 1898, balance available		11,648.98

Submarine-mine defense.—Acting under orders of the Chief of Engineers, immediate steps were taken to provide for the torpedo defense of New Orleans, La.

It was impossible to determine the nature of the service required, and the moment it might be called upon to obstruct the entrance of an enemy's fleet or cruiser with accompanying torpedo boats bent upon the destruction of such property as might be within the radius of their operations. In the absence of any regular torpedo supplies all haste was made to extemporize torpedoes which, while not understood to be as efficient as regular models, would serve immediate requirements.

The officer in charge was without allotment of funds to do anything, but the Citizens' Committee came to his relief and furnished what was requisite, under the understanding that no claims would be considered as attached to the United States unless money was appropriated by Congress for the service.

The nature of the localities where the torpedoes were to be used made it necessary to use rather substantial devices. The water in the river is very deep, the current very swift, and the situation was greatly complicated by the heavy drift. Boiler-iron cases were used, the size being regulated greatly by the material available. Although the full number was not planted, those put in place seem to have answered very well. After the buoyant mines of improvised pattern had been placed nothing further was done until the arrival of the regular outfit.

In the work at the forts the difficulties would have been almost insurmountable had it not been for the service of Lieut. Henry Jervey, Corps of Engineers, whose industry and devotion to duty under rather trying circumstances are worthy of commendation. Capt. G. McC. Derby, Corps of Engineers, also contributed greatly to the success of the operations by lending three very fine barges, which are still in use. Maj. J. H. Willard, Corps of Engineers, also tendered the use of the snag boat *Meigs*, and it is believed that this vessel has probably proved better adapted to this particular work than anything of the kind to be found in this vicinity. It was indeed a fortunate thing that it could be secured. The officer in charge is confident that much of the success attending the planting of the mines was due to the valuable service of this boat, and its very efficient crew.

Lieutenant Jervey's report is attached and attention is invited by the officer in charge to the recommendations which he makes relative to the torpedo material and the location of the grand junction boxes, etc., and to the mention of the valuable services of the Engineer Battalion detachment, which, it is believed, is of itself sufficient to point out the advisability of having a sufficiency of such men to perform all the duties connected with the planting and care of the mines. A good deal of reliance has necessarily been put upon such expert assistants as could be obtained, fortunately with good results; but it must be evident that some time was necessarily consumed in imparting to these gentlemen the knowledge which is obviously specific, and which had better remain in the possession of the army officers, who can be held to strict accountability under military regulations.

Money statement.

Amount allotted from appropriation for "National Defense"	$11,500.00
Amount allotted from appropriation for "Torpedoes for Harbor Defense, January 1, 1899"	15,000.00
	26,500.00
June 30, 1898, amount expended during fiscal year	5,139.96
July 1, 1898, balance unexpended	21,360.04
July 1, 1898, outstanding liabilities	8,526.27
July 1, 1898, balance available	12,833.77

REPORT OF FIRST LIEUT. HENRY JERVEY, CORPS OF ENGINEERS.

FORT JACKSON, LA., *July 1, 1898.*

MAJOR: I have the honor to submit the following report of operations in connection with the submarine-mine defense of the harbor of New Orleans, La., to include June 30, 1898.

Having reported on April 16, 1898, at New Orleans, La., for duty under your immediate orders, as per Special Order No. 82, Headquarters of the Army, Adjutant-General's Office, dated Washington, D. C., April 8, 1898, I was by your verbal directions assigned to the work of establishing a system of submarine mines to obstruct the Mississippi River. * * *

Previous to my arrival the district officer had decided to establish a skirmish line as soon as possible, using extemporized material, and had already given orders for the manufacture or purchase of the same, including mine cases, anchors, fuse cans, and circuit closers. Purely automatic operation was contemplated, and it was deemed inexpedient to provide any "cut-off" apparatus, whereby a mine could be insulated from the shore after or simultaneous with its explosion.

* * * * * * *

The embrasure of the mining casement had been blasted down to the water surface to permit the entrance of the cables. Mine cases, anchors, and junction boxes for two grand groups had been delivered; also 20 improvised mine cases for the skirmish line. No cable had been delivered.

A small coasting lumber steamer, the *Dial*, had been engaged to lay cables and plant mines, and she was present for duty. She was provided forward with a gaff or boom hung from her mast, and capable of swinging through an arc of about 150 degrees aft of the mast. The hoisting engine, forward of the mast, could readily lift the heaviest anchor with a double purchase, but was very unreliable, being destitute of a brake. Deck room between engine room and mast was ample for taking on board six or eight torpedoes and their anchors. The rails were high above the deck and the boom was too short to swing clear of the rail, which made it very awkward to lower a heavy weight overboard. The permanent crew consisted of captain, pilot, engineer, fireman, steward, and deck hand.

Preliminary operations: On April 21, 1898, carpenters started the work of fitting up the mining casemate with the usual operating and testing tables and shelving. On April 22 a small frame building, 14 by 28 feet, for the loading room, was started near the river. A heavy drum frame was also built.

As it had been decided to extemporize a cable for the skirmish lines by lashing an insulated copper wire and a steel wire rope together, I made requisition at once for the necessary wire rope, insulated wire, marline, etc., set negroes to work overhauling and strengthening hoisting gear of steamer *Dial*, put in a new stop stay to gaff, and renewed heel tackle and all hoisting lines. By the end of the third day most of the above preliminary work had been completed, the drum frame, reels of wire rope, and twelve or thirteen anchors had been loaded on the *Dial*, and ranges for the location of mine lines had been established. Three men had been added to the permanent crew of the *Dial* and a foreman with eight laborers or sailormen selected to assist the officer in charge of work on the water.

Planting the skirmish line: The general plan was as follows: First, a three-fourths inch wire rope was laid from the casemate to the opposite bank of the river and made fast at each end. This wire rope was then underrun, beginning at the farther shore, and the electric wire and mines were attached as the wire rope passed over the bow of the boat, the necessary stops being made by clamping on to the wire rope and allowing its weight to hold the boat at anchor.

Laying main cable: All was ready on Sunday morning, April 24. The *Dial* ran in to the bank as close as possible; the end of the wire rope was taken ashore by a large gang of men and hauled up to the casemate, a distance of about 800 feet. The end was made fast to a large timber placed on the inside of the embrasure and a turn was taken around another large timber buried as a "deadman" on the shore side of the levee. The drum or reel of wire rope had been mounted on the forward part of the boat and the rope arranged to lead aft through a snatch block placed at the stern. The shaft on which the reel turned (a 2-inch round bar) was lashed fast to the deck and a friction brake, consisting of a piece of scantling pressing upward against the edge of the reel, was arranged to check the rotation of the drum on its axle.

The *Dial* moved slowly from her first position downstream to the engineer wharf, to which she was moored, while a second reel of wire rope was spliced to the first, in order to have enough for a continuous run across the river. This run was made in the afternoon without difficulty. Range poles had been pointed out to the pilot to enable him to direct his boat, but in making allowances for the pull of the cable the boat was given too great a headway up the river and the rope was consequently laid several hundred feet farther upstream than was intended.

The farther end of the cable was fastened to a stout tree and an anchor 30 or 40 feet from shore was also attached. To the latter a buoy was moored to aid in picking up the cable.

Work in loading room: The loading room was completed early Sunday morning. The dynamite and fuses and other materials were received the same day. Assistant Engineer Horace Marshall, of the Vicksburg district, who had accompanied me from New Orleans, kindly offered to supervise operations in the loading room. He personally taught several ordinary laborers to load fuse cans and torpedoes. The dynamite was delivered in paper-wrapped cartridges and had to be crumbled by hand and packed in the fuse cans. Nearly all engaged in this work were affected with the usual violent headache resulting from nitroglycerine poisoning. All the torpedoes, fuse cans, and circuit closers for the skirmish line were loaded and assembled under Mr. Marshall's directions, and I desire to express herein my acknowledgment of the valuable services rendered by him.

Planting the mines: On Monday morning, April 25, six loaded torpedoes and all accessories were placed on board the *Dial*. In the afternoon the farther end of the cable was picked up and the cable placed across the bow of the *Dial* through a large snatch block. The boat moved out from the shore to about 30 feet of water, where a stop was made and mine No. 1 planted. A piece of wire rope was joined loosely to the main cable by a shackle between two wire-rope clamps, then carried to the anchor at such a distance as to permit the anchor to be lowered to the bottom of the river while the main cable was still held on the bow of the boat. From the anchor to

the mine case the mooring rope was given a length, depending on the depth of water, sufficient to submerge the mine about 15 feet at the existing stage of the river. All wire-rope connections were made with clamps, thimbles, and shackles.

The wire rope was attached as described and laid out on the deck in smooth coils. The firing plug was then screwed into the mine case, the electric wire attached to the plug and laid out along the wire rope, to which it was securely fastened by wrappings of marline. Enough slack was left at each change of direction to prevent a tensile strain from coming on the electric wire.

All connections being complete, the mine was hoisted overboard and allowed to float alongside the boat. The anchor was then hoisted over the rail and slowly lowered to the bottom by a slip line passing through the shackle, or through a short rope strap attached to the mooring ring of the anchor.

The boat was then moved slowly along the cable, the electric wire lashed as the cable slipped through the snatch blocks until the position of the next mine, at about 150 feet from the preceding, was reached. The operations above described were then repeated, with minor changes suggested by experience.

Two mines only were planted the first day; the position for the third mine was buoyed that night, and the cable dropped in about 150 feet of water. Much time was lost the next day in picking up the cable and putting it in the snatch blocks. Four mines were planted the second day, and the *Dial* was left in midstream that night moored to the main cable. A high west wind and an unusually swift current made work very difficult on this day.

On the third day, April 27, a mid-channel buoy was placed, leaving a sailing gap of about 500 feet wide in the center of the river, and five mines were planted. These mines were brought out to the *Dial* by a small tug that happened to be at the fort with a raft of piles. A sixth mine was made ready to plant, but it was found to be impossible to screw in the firing plug on account of defective threads in the mine case. The *Dial* was again moored in the river over night, and another mine brought out the next morning in a large yawl and planted, making twelve in all.

At this time I received orders to leave the sailing gap close to the shore, instead of in the middle of the river. It was impossible to underrun the cable again and close the mid-river gap, except by destroying the insulated wire attached to the cable. The twelfth mine was within 600 feet of the shore, so I decided to make this the last mine, and to leave the two gaps.

At the position of the twelfth mine the main cable fouled on some immovable obstruction in the river bottom, and all the power of the steamboat could not release it. I was therefore obliged to buoy the end of the electric wire at this point, drop the cable, and start underrunning from the shore end, in the hope that I might clear the obstruction by this method. All went well until we neared the wharf, when the cable again refused to let go of the bottom. No effort could break the hold. I had no more wire rope, and there was a gap of 600 or 700 feet in my electrical connection, the wire for which I had laid from shore as we underran the cable. To close the gap I used a 2-inch manila rope fastened alongside the electric wire and paid out through the hawse hole as the boat moved until we reached the buoyed end of the electric wire at mine No. 12. The joint here completed the connection, and the line was ready for operation. An anchor weight was placed about the middle of the manila rope to hold it to the bottom.

Just as we were completing the final joint a part of a raft of piling moored to the levee near the cable crossing broke loose, caught the cable over a pile end, and rode along with it until it met the obstruction near the wharf, where it stopped. Some of the piles twisted over the cable, and the whole lot sank out of sight in the course of an hour or two. Electrical test showed a break in the insulation.

Saturday morning, April 30, the *Dial* managed to grapple the pile raft and to clear it from the cable; the electric conductor had been torn off and rolled up into a tangled bunch. This was renewed, and the line finally completed Sunday morning, being just one week since work commenced on the water.

Difficulties and delays: First. Those due to natural conditions. The great depth of water, 95 to 165 feet, and the swift current of the river increased the usual difficulties of every operation. It was impossible to obtain accurate soundings in the absence of skilled leadsman and suitable lead lines, and the depressing effect as well as the direction of the current was a matter of great uncertainty. The heaviest anchors, over 3,000 pounds weight, would be swung 75 to 100 feet out of position while sinking to the bottom. Ordinary block buoys and sometimes even oil barrels used for buoys were carried under by the current and were soon cut loose by driftwood, rendering it impossible to keep any permanent marks and difficult to measure accurately the submergence of the mines.

Second. Those due to method of planting adopted. It proved to be a great mistake to lay a cable entirely across the river with the expectation of underrunning it *successfully*; but no one conjectured the extent of the obstructions in the bottom of *the river* at this point. It would have been better to anchor a barge at the position of *each* mine and to lay the cable with electric wire attached in short lengths from barge

to barge, at least two of which would have been required for this purpose. The electric wire (preferably two or three wires) should have been attached to the wire rope by a close and continuous wrapping of tarred twine, or, better still, annealed wire, put on before the cable was laid.

Third. Those due to the plant available. The high bows of the *Dial*, 10 or 12 feet above water, and her high rails, with the deficient length and swing of her gaff, rendered all operations of hoisting and lowering difficult and tedious. All heavy material had to be rolled from the shore upon a barge before the *Dial* could reach it with her tackle. The absence of a brake on the hoisting engine has already been referred to. In lowering anchors and torpedoes over the side, they invariably caught against the rail or side and had to be pried and pushed off by main strength, occasioning great loss of time.

Force employed and cost: In addition to the crew employed on the *Dial*, two crews of skilled oarsmen, 14 men, with two yawl boats, executed errands and transported men and supplies, beginning April 27. About three men were employed in the loading room, and two or three men as watchmen. The steamer *Dial* was employed solely for the skirmish line from April 21 to May 4, inclusive, but she had been waiting here for material since April 14, 1898.

Cost of steamer *Dial* 21 days, at $50 per day	$1,050	
Labor of planting	124	
Other labor, including building, oarsmen, transferring material, watchmen, etc	495	
Total cost of labor		$1,669
Estimated cost of materials:		
8,000 feet wire rope	$340	
20 mine cases, at $80	1,600	
20 circuit closers, at $8	160	
20 anchors	1,800	
15,000 feet insulated wire	150	
1,200 pounds dynamite	300	
Sundries	100	
Total cost of materials		4,450
Total estimated cost of skirmish line		6,119

Remarks on the extemporized material: The mine cases did not have buoyancy enough to support, without undue submergence by the current, the long mooring ropes and cables required. In some of the mine cases the end tapped for the plug had rounded surface, so that a water-tight joint between the plug and the case was impossible with the ordinary lead washers. The plug and the loading hole should both have been threaded for a greater length, and they should have been more accurately fitted. One case could not be used on account of the defective threads, and another had the hole broken.

The anchors were heavier than necessary (I think 2,500 pounds would have been ample), and they were rough, inferior castings, which cut or chafed the sides of the boats whenever they chanced to come in contact.

Casement and loading room: The bulk of the casemate and loading-room material for two grand groups arrived from Willets Point on April 24, and was transferred from the levee to storage places. On the 26th, Mr. L. C. Reed and his assistant, Mr. Case, and four workmen (all being young men engaged in electrical work in New Orleans) reported to me for duty and were directed to unpack and install the casemate apparatus, which they accomplished very skillfully in three or four days. Under the direction of the officer in charge, they proceeded to adjust and assemble circuit regulators and closers, to test fuse and cut-offs. All of the material furnished was of the old pattern, and much trouble was experienced in making adjustments. Forty-two regulator plugs out of forty-eight were finally put in good order and assembled with circuit closers. No service detecters were on hand at this time (none came until June 25), and a Bradley galvanometer and testing battery had to be used instead, being carried back and forth from casemate to loading room as circumstances required.

On April 30 Sergeant Newman, Privates Carlos, Koch, Reddicks, and Murphy, all of Company A, Battalion of Engineers, reported for duty. They had been assigned to Battery D, First Artillery, at Fort St. Philip, for quarters and rations, but were placed under my orders for torpedo service. I mustered them and set them to work cleaning plugs and switch boxes. By the 2d of May, Monday, a number of circuit regulators, fuses, and cut-offs had been made ready and were turned over to the sergeant for loading. Several days were lost in futile efforts to load the switch or cut-off boxes *properly, due to* the sharp, unfinished edges of the holes in the boxes,

which cut through the insulation of the fuse wires, and to the deterioration of the loading wire. The pure rubber insulation of the latter had softened to such an extent that it could be easily penetrated with the finger nail, and it had cracked in innumerable places. The pressure of the rubber packing against the wire when the glands were screwed in tightly in many cases broke the insulation and permitted contact between the loading wire and the metal of the box. Only after repeated efforts were we successful in insulating the wires sufficiently to stand the usual test in air. When tested in water, the loading wire showed considerable leakage, sufficient to reduce the normal resistance of a triple group by one-half. The deterioration of the wire was reported, but it was impossible to procure in New Orleans suitable wire to take its place, on account of the unusual size of the holes through the glands, and I was directed to do the best I could with the material furnished. From my experience I should recommend that the present form of switch box be condemned, and that glands, where used, be bored to receive some common commercial size of gutta-percha or rubber-covered wire.

By May 5 all the material for one grand group, except the cable and mooring rope, was on hand and prepared for use.

Planting the grand groups: On May 4 the steamer *Dial* was discharged, and at dusk on May 5 the United States snag boat *John R. Meigs* arrived for service in planting the rest of the mines. On May 7 the first shipment of cable arrived. It consisted of one-half mile of multiple cable and 4 miles of single conductor cable, in two drums. About 10,000 feet of wire mooring rope was delivered. The single conductor cable was cut at once into proper lengths for laying between grand and triple junction boxes and turk heads made on each end. A sounding lead was cast and a new line graduated. Capt. P. R. Starr, master of the steamer *Meigs*, commenced the work of arranging the lines and anchors on a large barge, 24 by 120 feet, which was to be used as grand junction box boat. Early Monday morning, May 7, the wind and weather being favorable, this barge was towed out and anchored in the center of the river at the intersection of ranges previously established, four upstream anchors and one side anchor being used. The multiple cable drum was then mounted on the deck of the *Meigs* and the cable laid the next day. The half-mile was just enough to reach from casemate to grand junction box. By running the cable around the smooth capstans and through snatch blocks, the speed of unreeling could readily be regulated, and the laying was accomplished without difficulty, excepting that the weight of the cable almost turned the *Meigs* around, due to her small draft. The grand junction box was fastened to the deck of the barge and the multiple cable secured in it and also lashed to the barge. Triple group No. 4 was the first to be planted. A large yawl 18 feet long was moored 100 feet astern, bow upstream, by a line from the barge to serve the triple junction box. To prevent accidents, a second yawl was fastened at the stern of the first. The steamer *Meigs* also hung onto the barge by a line to assist her in moving easily to the position of the mines. Soundings were taken and the mooring rope and cable measured and cut on board the barge and brought on board the *Meigs* for attachment to the mines and anchors. The general method of planting adopted is as follows: The anchor, set on edge, was rolled down to the bow of the boat, where the deck is only a few inches above the water, and there chocked. The iron deck is rounded off at the bow and slopes down toward the water, so that when the chock was removed the anchor would roll off into the river. The mine case, which had its proper number painted on it in large figures, was made ready by screwing in the compound plug, making the core joint, and clamping on the cap. It was then rolled over to one gunwale, where it rest d about a foot above the water. The sockets were then leaded onto the extremities of the wire mooring rope and shackled to the mine case and anchor, using sister hooks in the eye of the latter.

Care was taken to pass the mooring rope and cable on the outside of all rigging and projections from the boat, so that there would be no fouling of lines. The free end of the cable was passed along the guards of the steamboat, where it would be out of the way. All of this work was done while the boat lay alongside the barge. The boat then proceeded to the position of the mine. When nearly there the torpedoes were rolled overboard and held by a line. When exactly at the site, the anchor was rolled over and allowed to go by the run. This method of planting worked well with mooring ropes 175 feet long, and in only one instance did the lines foul by catching on a projecting pin or bolt. After the mine was planted the free end of the cable was taken to the triple junction box boat and jointed to the switch box. The yawl was a little unsteady for work, but it was decided to try it on another group, where it would have to be anchored. Therefore, at triple group No. 5 an anchor was placed by the *Meigs* and the yawl moored as before. It was impossible to haul the yawl up immediately above the anchor, and the bow was pulled almost under water until the men took their places, keeping most of the weight astern. The triple junction box and all the cables had to be lashed firmly to the boat, and any sudden movement would have capsized her. When group 5 had been planted and we attempted to raise the box, the lashings gave way suddenly and the cable swept the small boat, taking one man over with them. The man went under the

Meigs, but, fortunately, fell clear of the cables and came up on one side, where he was soon picked up. This accident and the general unsteadiness of the small boats made me abandon their use and take another barge for use as a triple junction box boat. This was a rather awkward and slow boat to handle, but was much safer, because acting as a pivot for the *Meigs* to maneuver from. The triple junction box boat was usually held in position by one large anchor. The current and wind caused more or less swinging of the barges, and accurate placing of boxes and anchors was impossible. Two small barges 50 by 10 feet would have been most convenient for this work. On May 14 we completed the six triple groups of the first grand group. No. 1 was omitted on account of the sailing gap required. It will thus be seen that one day was required for laying multiple cable and four days for planting six triple groups, much time being lost in shifting the barge. In testing the multiple cable laid to the first grand group it was discovered that two cores were broken, the break being located in the moat. A single wire was laid to take the place of one defective core. The other was not required, as there were only six groups to be sewed. Two more drums of multiple cable having arrived in the meantime, preparations were made to plant the second group immediately. The cable for this was laid on May 18, and the last mine planted May 24. One day was lost waiting for dynamite, one Sunday intervened, and considerable delay was occasioned by having to raise and reload two mines that showed a closed circuit when lowered into the water.

Tests and repairs: The resistance of each circuit regulator plug was measured in the casemate and tabulated, the plug and mine in which it was placed being each given a number for identification. Each compound plug after being loaded was tested with a Bradley galvanometer and one cell of the testing battery. No tests of loaded mines were made from the casemates, as I considered such tests not only highly dangerous, but unnecessary. During planting the tests were made from the grand junction box boats, with the galvanometer and battery already mentioned; any leak of importance could be readily detected by the 150-ohm coil of the Bradley.

Most of the mines showed perfect insulation when planted, but after the switch box was immersed some leakage appeared, which generally increased with time; this is supposed to be due to the defective loading wire. The triple junction boxes in the second group were filled with melted paraffine and wax around the switch box to prevent leaks; very little good resulted. I suppose that at the depths in which the switch boxes were placed (not less than 90 feet) the moisture is forced through all the protective coverings.

No repairs have been made to the mines since they were planted (although the electrical condition is poor in several), as it was feared that an attempt to underrun the cables would prove disastrous. One attempt between a triple junction box and a mine resulted in a broken cable. In endeavoring to raise an anchor a three-fourth inch wire rope in one case, and a 2¼-inch diameter new Manila rope in another were broken without budging the anchor. The force of the current against the cables is great, and the single conductor cable is not strong enough to endure it long. The grand junction boxes were buoyed when planted, but the buoys have disappeared, so it would probably be necessary to underrun the multiple cable in order to reach the grand junction box, and experience with the skirmish line shows the probability of fouling some obstruction on the river bottom.

Force employed and cost: The whole crew of the steamer *Meigs* was employed from May 6 to May 31, inclusive, at a cost of about $30 per day. When at work planting mines and laying cables, an additional gang of from four to six common laborers was employed. These men did all the heavy work of handling lines and moving weights, while the detachment of engineer soldiers was limited to the special work of assembling torpedoes and junction boxes, making attachments and joints, besides doing the work in the loading room. One extra man, a blaster, assisted in loading the mines. The crews for the yawls were used for transporting men, and were required to lend a hand at other work about the boat whenever extra force was needed. Since May 31 the crew of the *Meigs* has been reduced to the smallest number consistent with the proper care of the boat, extra labor being hired from the fort when there is work to be done.

Estimated cost of labor:

Crew of steamer *Meigs*, May 6 to 31, 26 days, at $30	$780
Crew of steamer *Meigs*, June 1 to 30, 30 days, at $15	450
Crews of yawl boats to May 31	480
Extra crew of steamer *Meigs*, 4 men, 22 days, at $1.50	132
Service of electricians in casemates and loading room, to June 31, 1898	500
Transferring material, building, etc	150
Watchman to June 30, 1898	400
Total estimated cost of labor	$2,892

Estimated cost of materials, exclusive of those furnished by the torpedo depot:		
10,000 feet ¾-inch wire rope	$425	
4,000 feet Manila rope	350	
4,000 pounds dynamite at $0.25	1,000	
Total estimated cost of materials		$1,775
Total estimated cost of labor and materials (exclusive of those from depot) for planting two grand groups and maintaining mine defenses		4,667
Deduct labor for maintenance during June, 1898		800
Balance		3,867

Condition of mine system: Three mines of the skirmish line and one from the Grand Group No. 1 went adrift, but they have all been recovered. One was evidently cut off by a propeller; in the others the mooring rope was broken, as by bending—due, probably, to the action of the current. In another mine of the grand group the electric cable was broken off short at the turk's head, but the mooring rope was still intact; in still another the anchor had slipped from the sister hooks in lowering and the mine had hung for several weeks by the cable alone. The mooring rope for several of the mines first planted was cut too long, and two mines have been in sight above the water surface since the river commenced to fall. This is due to the slackening of the current rather than to the small decrease in depth. They will be adjusted as soon as the river reaches its lowest stage.

Electrical tests showed a closed circuit in several of the mines, and the resistance of most of them is below the normal, but the automatic action of the system, with few exceptions, is reasonably certain.

The casemate apparatus and batteries seem to keep in fair order in spite of the unavoidable dampness of the floors and walls. All the stands were heavily paraffined when the apparatus was first set up, and there is little leakage to the ground. Several cells of the firing battery are defective, and the Bradley galvanometer shows leaks through the rubber insulation of its binding posts.

A supplementary firing battery consisting of 100 dry cells was sent down by the Edison Electric Company, of New Orleans, La., before the regular apparatus arrived. It was installed in the casemate, and switches have been arranged to throw either one or both firing batteries through the mines. The dry cell battery is very effective and takes up much less room than the standard Leclanché cells.

An apparatus that has proved of great value and convenience is a "Queen's testing set" belonging to Mr. Reed; it consists of a Wheatstone bridge, deadbeat galvanometer, and a battery, all in a box about the size of the post-office bridge, and very compactly arranged. I should recommend its adoption as part of the permanent outfit of each casemate, and as highly useful in testing from the boats during planting.

A branch circuit from the electric-light plant of the fort has been run in the casemate, and six or eight incandescent lights placed over the operating and testing tables. Since this was done a 4-horsepower Hornsby-Akroyd oil engine and a rotary transformer have been received and installed in the mining casemate for use with the new pattern firing apparatus. The transformer, when run as a generator, is able to supply sufficient power for the lights in the casemate, thus giving an independent lighting plant which can be started up on short notice. Temporary observing stations for torpedo service have been established.

These should connect with each other and with the mining casemate by telephone, and the telephone circuit for torpedo service should be capable of operation independently of that for the service of the batteries. This can probably be accomplished with three-cored cable that has been furnished by the Signal Department and laid under my direction. We have now temporary telephone communication between the headquarters building at Fort St. Philip and the engineer office at this point, a telephone having been borrowed from the signal officer at the former post. No material has been furnished on this side the river for telephone lines, but I have used some wire belonging to the torpedo department for the temporary line.

Recapitulation.

The following is a brief summary of work done from April 21 to June 30, 1898:

1. Mining casemate fitted up and loading room built.
2. Skirmish line of 12 extemporized mines planted.
3. Grand group of 18 mines planted.
4. Grand groups of 21 mines planted.
5. System maintained, drifting mines recaptured.
6. Oil engine and rotary transformer installed.
7. New mines cleaned, plugs and circuit regulators cleaned and assembled.

* * * * * * *

The steamer *Meigs*, while on maintenance duty, has been useful in a number of ways to the engineer force engaged in building the batteries by transferring material between the forts, towing barges, pulling snags, etc. She was also engaged two days in laying the telephone cable for the signal department. I desire to express my acknowledgment to Capt. P. R. Starr, master of the snag boat *John R. Meigs*, for untiring energy and skill in handling his boat and the torpedo material, and for valuable suggestions and assistance in planting the mines; also to Asst. Engineer C. A. Miner and his assistants, Messrs. Quinn and Bush, of the Engineer Department at large, for furnishing labor and for ready and willing cooperation whenever requested. In the electrical work I have been assisted by Mr. L. C. Reed and Mr. Case, of New Orleans, La., who have shown great aptitude in grasping the details of the torpedo system, and have been careful and painstaking with their work.

The detachment of engineer soldiers is deserving of special commendation. Sergt. John Newman, an old and tried member of the battalion, has been in charge, and all have performed their duties well and rapidly. They have cheerfully made the best of inconveniences and hardships, and not a single breach of discipline has come to my notice. Private Peter Murphy, Company A, Battalion of Engineers (one of the detachment), was discharged by reason of expiration of term of service on June 4, 1898.

Present cost of maintenance.

United States snag boat *Meigs*, per month	$450
Watchmen, per month	200
Electrician, per month	150
Total	800

Very respectfully, your obedient servant,

HENRY JERVEY,
First Lieutenant, Corps of Engineers.

Maj. J. B. QUINN,
Corps of Engineers, U. S. A.

Sabine Pass: Temporary siege batteries and battery for 8-inch rifle, mounted on 15-inch smooth-bore carriage.—Letter of the Chief of Engineers, April 6, 1898, directed that temporary siege batteries, to consist of two 5-inch siege guns and two 7-inch siege howitzers, be at once erected at Sabine Pass, Tex., for its defense, the platforms to be of the style of ordinary siege platforms, except that pintle be used and sand parapets, with timber revetments, be made. For this purpose the sum of $3,000 was allotted from the appropriation for "National Defense," act of March 9, 1898. A further allotment of $1,200 was made from the same appropriation, in letter of June 13, 1898, for the completion of these batteries.

In accordance with instructions, an estimate was furnished on April 15, 1898, of the cost of mounting a temporary siege battery, according to above project.

Work was commenced on April 9, 1898, the necessary material ordered, and site for battery selected, the consent of the owner being obtained in writing on April 11, 1898, for its temporary occupation by the Government. Contracts were awarded for the necessary lumber, teams, etc.

The lines of the battery were laid out and earthwork commenced and pushed as rapidly as possible until June 15, 1898, when operations were suspended pending an allotment of additional funds. This allotment has since been made.

The magazine, with approach, two tables for guns, revetment, and office building have all been completed, and the earthwork is so near completed that it will require but a few days' work to finish it.

On May 2, 1898, two carriages for 5-inch B. L. siege rifles and two carriages for 7-inch B. L. howitzers, together with armament and ammunition, were received; and on May 8, 1896, the guns having

arrived, they were mounted in the battery. On May 16, 1898, telegraphic order was received from Chief of Ordnance to ship all guns, carriages, armament and ammunition, pertaining to these guns, to the ordnance depot, Tampa, Fla. In accordance with these instructions, the guns, material, etc., were turned over to the Assistant Quartermaster-general, U. S. Army, New Orleans, La., for transportation to Tampa.

Four light 12-pounder bronze smooth-bore guns and carriages for same have since been received, taken to site of battery and mounted, but have not as yet been put in place, as the emplacements will have to be arranged to accommodate these field guns.

Letter from the Chief of Engineers, April 27, 1898, directs the mounting at Sabine Pass of one 8-inch B. L. rifle, on strengthened barbette carriage for 15-inch smooth-bore guns, by using steel cradle. Emplacement to be built substantially according to latest type adopted for 15-inch smooth-bore carriages. A provisional allotment of $6,000 was made for this purpose, from the appropriation for "National Defense," act of March 9, 1898.

Earthwork was begun on this battery on June 6, 1898, and about one-fourth of same have been completed. All material for platform, magazine, etc., has been ordered, and is now at the site of the battery. Work on the magazine and platform has been commenced, and is being pushed as rapidly as possible.

Wharf.—Indorsement of Chief of Engineers May 19, 1898, authorized the construction of a wharf at Sabine Pass for the landing of material, heavy guns, carriages, etc., on account of the isolated condition of the battery. For this purpose the sum of $3,120 was allotted from the appropriation for "National Defense," act of March 9, 1898.

The wharf, 960 feet long, has been completed with the exception of the connection of same to the ballast wharf.

Money statement.

Amount allotted during fiscal year	$13,620.00
June 30, 1898, amount expended during fiscal year	3,821.34
July 1, 1898, balance unexpended	9,798.66
July 1, 1898, outstanding liabilities	2,662.00
July 1, 1898, balance available	7,136.66

Submarine mine defense.—A letter from the Chief of Engineers, April 19, 1898, allotted the sum of $2,000 from the appropriation for "National Defense," act of March 9, 1898, for the purpose of providing a submarine mine defense in the harbor at Sabine Pass, Tex.

Arrangements were made for a house barge for landing torpedoes. Lumber for submarine mine cave was received and transferred to site of work. Mines, dynamite, and electrical supplies were transferred to the house barge on receipt, but have since been stored in a safe place, pending the receipt of cables.

Owing to a change having been made in the flanking position of the gun batteries, these mines were not laid until the arrangement of the guns could be determined upon. Pending this decision instructions have been received which it is thought indicate that these mines will not be planted, and meanwhile the mines will remain in storage.

Money statement.

Amount allotted from appropriation for "National Defense"	$2,000.00
Amount allotted from appropriation for "Torpedoes for Harbor Defense, January 1, 1899"	1,600.00
	3,600.00
June 30, 1898, amount expended during fiscal year	480.67
July 1, 1898, balance unexpended	3,119.33
July 1, 1898, outstanding liabilities	1,025.47
July 1, 1898, balance available	2,093.86

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DEFENSES OF GALVESTON, TEXAS.

Officers in charge, Lieut. Col. Alexander M. Miller, Corps of Engineers, until September 10, 1897; Capt. Charles S. Riché, Corps of Engineers, from September 10, 1897, to June 16, 1898, and Maj. James B. Quinn, Corps of Engineers, from June 16, 1898; assistants, Capt. Charles S. Riché, Corps of Engineers, until September 10, 1897, and Lieut. Harry Burgess, Corps of Engineers, from April, 11, 1898; Division Engineer, Col. Henry M. Roberts, Corps of Engineers.

Mining casemate.—This was completed on June 30, 1897, at a cost of $15,009.27.

Money statement.

July 1, 1897, balance unexpended		$5,503.94
June 30, 1898, amount expended during fiscal year	$4,802.92	
Amount deposited to credit of appropriation	701.02	
		5,503.94

Emplacements for 10-inch guns.—This battery was commenced November 23, 1896. At the end of the last fiscal year the platforms were complete, and the concrete of emplacements completed except for about 800 yards of concrete and the granolithic surfacing.

The concrete work was finished on August 30, 1897; 760.2 cubic yards Rosendale concrete and 201.89 cubic yards granolithic surfacing having been placed between June 30 and that date.

The earthwork in parapet was completed on December 14, 1897. For this purpose 10,409.42 cubic yards sand and 1,213.32 cubic yards of mixed soil and shell were used, this latter being used to cover the sand to a depth of 1 foot. The top and slopes were sodded with Bermuda.

To protect parapet from wave action during storms, sheet piling was driven around foot of pararet, and riprap placed against outer face of piling, and on berm between piling and foot of parapet. Nine hundred and eighteen linear feet of sheet piling, and 1,799.84 tons of riprap were used for this purpose.

The remaining work on battery and the mounting of the carriage and gun in southern emplacement were completed April 1, 1898.

The other gun is on hand, but the carriage, which is for all-round fire, has not yet been received.

The platforms are built of Portland concrete, and the emplacements of Rosendale concrete.

Considerable settlement had taken place in this battery, but the base ring for the southern carriage was successfully leveled up, and

the level was not disturbed by the firing of the gun under full charge on May 3, 1898.

Cost of—

Rosendale concrete, per cubic yard, for this battery was	$5.6574
Portland concrete, per cubic yard, for this battery was	7.6533
Granolithic surfacing (0.2514 foot thick), per square yard	1.5365
Plastering, per square yard	0.2850
Bowlders for concrete, per cubic yard	2.35
Sand filling, per cubic yard	0.17
Soil, per cubic yard	0.18
Earth, per cubic yard	1.75
Riprap, per ton	2.00
Sheet piling, per linear foot	1.15

The total cost of battery was $116,520.21.

Money statement.

July 1, 1897, balance unexpended	$20,297.85
Amount allotted during fiscal year	17,500.00
	37,797.85
June 30, 1898, amount expended during fiscal year	36,818.06
July 1, 1898, balance unexpended and available	979.79

Mortar battery.—Under date of November 12, 1896, plans for a battery of eight 12-inch mortars were furnished by the Department with instructions to advertise the work, which was done on November 12, and bids opened November 30, 1896. Five proposals were received, the lowest being that of Henry L. Breneman, of Paris, Tex., with whom a contract was entered into on December 15, 1896, for constructing the battery.

Work under the contract was not commenced until February 20, 1897, and progressed very slowly up to the close of the fiscal year ending June 30, 1897, the condition of the work at that time being as follows: South half of the battery site raised to an elevation of 6 feet, the height over the remainder being from 2 to 5 feet above mean low water; the footings for all walls, except engine room and approaches, were completed; the foundation for walls as parados partly completed; gun platforms complete and ready to receive gun carriages; sheet piling complete and protected on outside with riprap.

The total amount of money expended to June 30, 1897, was $9,374.56.

During the fiscal year ending June 30, 1898, the work progressed very well, the condition of the work on that date being as follows: All concrete work completed; sand fill completed, loam covering and sodding finished; trolley beams and trolleys in place, gun carriages and guns mounted; with the exception of the installation of electric-light plant, the battery is ready to be turned over to the artillery.

The total estimated cost of the battery was $115,000, to cover which allotments have been made.

The total amount expended to June 30, 1898, was $97,520.05.

Money statements.

MORTAR BATTERY.

July 1, 1897, balance unexpended		$108,325.44
June 30, 1898, amount expended during fiscal year		87,145.49
July 1, 1898, balance unexpended		21,179.95
July 1, 1898, outstanding liabilities	$15,348.90	
July 1, 1898, amount covered by uncompleted contracts	5,827.67	
		21,176.57
July 1, 1898, balance available		3.38

MOVING AND MOUNTING CARRIAGES FOR MORTAR BATTERY.

Amount allotted during fiscal year	$1,600.00
June 30, 1898, amount expended during fiscal year	1,600.00

CLEANING, MOUNTING, AND UNLOADING ORDNANCE MATERIAL.

Allotted February, 1898	$4,000.00
June 30, 1898, amount expended during fiscal year	3,504.31
July 1, 1898, balance unexpended and available	495.69

REPAIRING TRESTLE.

Amount allotted March 26, 1898	$1,000.00
June 30, 1898, amount expended during fiscal year	31.75
July 1, 1898, balance unexpended	968.25
July 1, 1898, outstanding liabilities	746.50
July 1, 1898, balance available	221.75

PRESERVATION AND REPAIR OF FORTIFICATIONS.

Amount allotted April 15, 1897	$200.00	
Amount allotted December 14, 1897	300.00	
Amount allotted February 1, 1898	600.00	
		$1,100.00
June 30, 1898, amount expended during fiscal year		648.51
July 1, 1898, balance unexpended and available		451.49

Sites.—The Attorney-General having passed favorably on the title to one site, it was purchased and paid for on March 23, 1897. Another site, the title to which had been under investigation by the United States district attorney, was purchased February 21, 1898, the Attorney-General having passed favorably on the title.

Money statement.

July 1, 1897, balance unexpended	$36,000.00
Amount allotted March 25, 1898	4.75
	36,004.75
June 30, 1898, amount expended during fiscal year	36,004.75

Abstract of allotments made for fortifications at Galveston, Tex.

FOR MINING CASEMATE.

Act—		
August 18, 1890	$3,852.11	
February 24, 1891	1,469.08	
March 2, 1895	14,241.21	
		$19,562.40

FOR GUN BATTERY.

Act—		
June 6, 1896	$100,000.00	
March 3, 1897	17,500.00	
		$117,500.00

FOR MORTAR BATTERY.

Act—		
June 6, 1896	$2,700.00	
March 3, 1897	115,000.00	
		$117,700.00

FOR MOVING AND MOUNTING CARRIAGES FOR MORTAR BATTERY.

Act March 3, 1897	$1,600.00

FOR UNLOADING AND MOUNTING 10-INCH GUN AND CARRIAGE.

Act March 3, 1897	$600.00

FOR CLEANING, MOUNTING, AND UNLOADING ORDNANCE MATERIAL.

Act June 6, 1896	$4,000.00

FOR REPAIRING TRESTLE TO BATTERY SITE.

Act March 3, 1897	$1,000.00

FOR SITES FOR FORTIFICATIONS AND SEACOAST DEFENSES.

Act June 6, 1896	$71,015.40

FOR PRESERVATION AND REPAIR OF FORTIFICATIONS.

Act—		
June 6, 1896	$550.00	
March 3, 1897	550.00	
		$1,100.00

Two 4.7-inch rapid-fire emplacements.—This battery is designed for two 4.7-inch R. F. guns on pedestal mounts for all-round fire.

Work was begun on May 23, 1898, under allotments of $26,000 from the appropriation for "National Defense," act of March 9, 1898. The estimated cost of this battery complete is $50,000.

The driving of sheet piling around site was begun on May 30, 1898, by Contractor Moore, and completed on June 23, 1898. On June 7, 1898, Contractor Ketchum commenced on his contract to place sand within the area inclosed by sheet piling, and to riprap on the outside of the sheet piling. Up to June 30 he had placed 2,000 cubic yards of sand and 725 tons of riprap. This work is still in progress. On June 27 work was commenced on spur railroad trestle to connect track on jetty with site of rapid-fire battery. This work is now in progress.

Money statement.

Amount allotted April 13, 1898	$6,000.00	
Amount allotted April 29, 1898	20,000.00	
		$26,000.00
June 30, 1898, amount expended during fiscal year		4,058.00
July 1, 1898, balance unexpended		21,942.00
July 1, 1898, outstanding liabilities		2,626.15
July 1, 1898, balance available		19,315.85

Two 10-inch gun emplacements.—Preliminary work was begun on this battery on March 22, 1898, under an allotment of $100,000. The estimated cost of this battery is $115,000.

Necessary plant, offices, platforms, etc., were collected and set up, and 6,610 feet of standard-gauge railroad track was constructed to connect with the Galveston, La Porte and Houston Railroad, to be used in bringing up materials. This work was completed about May 1, 1898.

The driving of piles for foundation was begun on April 14, 1898, and completed on May 3. Nine hundred and fifty-four piles were used in foundation. The foundation was completed by a grillage of oil railroad rails running in both directions and embedded in the concrete. Concrete laying was begun on May 11, 1898, and up to date 5,310 cubic yards have been placed. On June 30 the condition was as follows: Both platforms complete and ready for base rings. In eastern half of battery the concrete of emplacements at an elevation of 25 feet, and on western half at an elevation of 17 feet. Roof beams, crane brackets, etc., in place.

Money statement.

Amount allotted during fiscal year	$100,000.00
June 30, 1898, amount expended during fiscal year	55,272.99
July 1, 1898, balance unexpended	44,727.01
July 1, 1898, outstanding liabilities	8,182.03
July 1, 1898, balance available	36,544.98

Two 8-inch gun emplacements.—This work is designed for two 8-inch B. L. rifles on Crozier-Buffington carriages, model 1896.

Work was commenced on collection of plant, building of offices, barracks, etc., on April 7, 1898, under an allotment of $100,000. Eight thousand four hundred and seventy-seven and one-half feet of standard-gauge railroad track was constructed to connect site of battery with Gulf and Interstate Railway, and with wharf for the purpose of bringing up materials.

Driving of piles for foundation began on May 6, and was completed on May 15. Seven hundred and seventy-six piles were driven in foundation, and on these a grillage of two layers of old railroad iron was placed.

Concrete laying began on May 31, and up to date 4,273 cubic yards have been placed.

The platforms were completed and ready for base rings on June 24, 1898.

Money statement.

Amount allotted during fiscal year	$100,000.00
June 30, 1898, amount expended during fiscal year	56,058.46
July 1, 1898, balance unexpended	43,941.54
July 1, 1898, outstanding liabilities	5,522.02
July 1, 1898, balance available	38,419.52

Cement testing.—Continued during the year under direction of Mr. S. M. Wilcox, assistant engineer.

Mine defense.—The following is the report of Lieutenant Burgess:

REPORT OF SECOND LIEUT. HARRY BURGESS, CORPS OF ENGINEERS.

GALVESTON, TEX., *June 30, 1898.*

MAJOR: I have the honor to submit the following report on the submarine mining defense of Galveston Harbor for the fiscal year ending June 30, 1898:

Prior to my reporting to Lieutenant Riché for duty on April 11, 1898, there were no active operations. Some matériel, however, had been received.

* * * * * * *

No cable could be obtained from the Engineer Depot nor from the factories. Major Knight had also informed Lieutenant Riché that nothing could be determined as to when cable for Galveston could be supplied. Lieutenant Riché therefore purchased about 90 miles of Crown insulated wire of No. 14 B. & S. gauge, unarmored, this being the best substitute for cable that could be obtained.

According to the plan contemplated for the utilization of this matériel each mine was to be connected directly to casemate, thus doing away with switch boxes. * * * It was necessary to use 60 per cent dynamite, as no 75 per cent dynamite could be obtained in the market.

In carrying out this plan a multiple cable was prepared by local electricians, while the detachment under my direction loaded the mines, prepared moorings, etc., and fitted up the casemate for service. This cable contains 44 wires, grouped about a central core of one-half-inch galvanized iron wire rope, the whole cable being wrapped spirally with canvas strips and passed through melted asphaltum. This cable is 1¾ miles long, 418,000 feet of wire being used in its construction.

No suitable boat for planting mines could be secured in Galveston. The best arrangement that could be made was to use the Government tug *Anna* to tow a derrick barge hired for the occasion. This barge has a hoisting engine and is well

suited to the purpose except for its lack of motive power. Whenever there is a high wind or rough water the tug can not handle the barge. For this reason for more than two-thirds of the time it was impossible to work on the water. This lack of a boat suitable for planting was one of the most important difficulties encountered, and was chiefly responsible for the slowness with which the work in Galveston Bay was done.

The cable described above was laid on the morning of April 23, it having been completed the day before. Buoys were then placed to indicate the position of the line of torpedoes. Orders were received on April 23 from the Chief of Engineers to begin planting, and at noon of the same date this was begun.

As soon as the planti g began, the weak point of this improvised system became apparent. While the cable was strong enough to resist the swift currents of Galveston Bay, the light wires connecting this cable with the mines were twisted and broken by the current, and often had to be replaced. The work on this temporary arrangement continued until the armored single-conductor cable was received on May 9. On that date only 15 mines were in place.

When this cable was received work was immediately discontinued on the temporary line, and arrangements were made to place skirmish line. On May 11 2 miles of single-conductor cable were laid to connect casemate to north end of skirmish line, and six of the mines planted. The last mine of the skirmish line was planted on May 23, and the south end of the line was connected to casemate by 2 miles of cable. During this period, from May 11 to 23, stormy weather prevented work on water for nine days. The actual time occupied in laying skirmish line was less than three days, the remainder of the time being used to replace leaking switch boxes, to place buoys, etc.

On May 25, 1¼ miles of multiple cable arrived and was laid in the afternoon of same day. The next day was spent in placing triple junction boxes, in laying cables connecting them to grand junction box, and in placing buoys to mark sailing gap. On May 37, triple groups 1, 2, 3, 4, and 5 were planted * * *

* * * On the 28th groups 6 and 7 were planted. On May 31 the three remaining buoyant mines were planted as a detached group north of the grand group, and connected to casemate by the single-conductor cable, which had before been connected to the north end of skirmish line.

During the planting of the mines at this place, the chief defect of the system which I noted was the leaking of switch boxes. Some of the switch boxes were loaded and reloaded four or more times before the leaks could be got rid of. Even after remaining in good condition for several weeks these switch boxes occasionally begin leaking and have to be taken up and reloaded.

* * * * * * *

About June 4, 12 of the new type circuit regulators were received, and groups 1, 2, 6, and 7 were taken up and the Abbot regulator replaced with the new type of regulator.

Lieutenant Hamilton reported for duty to Lieutenant Riché on June 6, 1898, and was assigned to torpedo work. On June 16 Lieutenant Hamilton was directed by you to take charge of all work connected with the casemate, while I was placed in charge of the remainder of the work. These are our present duties.

During June the mines have been daily tested and the defects discovered in this way have been remedied. The system has been kept ready for instant service in case of attack, both electrical currents, however, being cut off at battery terminals.

I would like to call attention to the conduct and service of the soldiers of the engineer detachment at this place. This detachment consists of Corporal Lansing and six privates of Company D, Battalion of Engineers. These men deserve especial commendation for the faithfulness, skill, and intelligence with which their work has been done.

The two newspapers of Galveston have given valuable aid in advertising the submarine defenses here, and have always carefully excluded from publication any information in regard to the submarine mining defense which might be of value to the enemy or detrimental to the interests of the United States.

The money allotted to this work to date is as follows:

March 18, 1898, from "National Defense"	$1,000.00
June 14, 1898, from "National Defense"	1,000.00
May 16, 1898, from "Torpedoes for Harbor Defense"	10,000.00
Total	12,000.00

Very respectfully, your obedient servant,

HARRY BURGESS,
Second Lieutenant, Corps of Engineers.

Maj. JAMES B. QUINN,
Corps of Engineers, U. S. A.

Money statements.

NATIONAL DEFENSE.

Amounts allotted	$2,000.00
July 1, 1898, balance unexpended	2,000.00
July 1, 1898, outstanding liabilities	860.61
July 1, 1898, balance available	1,139.39

TORPEDOES FOR HARBOR DEFENSE, JANUARY 1, 1899.

Amount allotted May 16, 1898	$10,000.00
June 30, 1898, amount expended during fiscal year	2,678.74
July 1, 1898, balance unexpended	7,321.26
July 1, 1898 outstanding liabilities	7,321.26

REPORT OF MR. S. M. WILCOX, ASSISTANT ENGINEER, ON CEMENT TESTING.

GALVESTON, TEX., *July 5, 1898.*

SIR: I have the honor to submit the following report upon tests of cement furnished for the fortifications at Galveston Harbor, Texas, for the fiscal year ending June 30, 1898:

Brands of cement: The following are the brands of cement, number of barrels, and the names of the dealers:

	Barrels.
First. Open market purchase, Galveston, Tex.:	
"Alpha," American Portland cement, from Wm. Parr & Co	600
"Hemmoor," German Portland cement, from Wm. Parr & Co	400
"Heyn Bros.," German Portland cement, from W. H. Pollard & Co	1,043
"Dyckerhoff," German Portland cement, from W. H. Pollard & Co	850
"Kronsberg," German Portland cement, from W. H. Pollard & Co	500
"Porta," German Portland cement, from National Building and Supply Company, New Orleans, La., H. L. Ziegler, agent, Galveston, Tex	1,000
"Kaiser," as above	400
Second. By contracts entered into April 16 and 17, 1898:	
"Porta," as above	1,800
"Kaiser," as above	1,000
"Lagerdorfer," German Portland cement, from J. G. Clark, New Orleans, La., H. L. Zeigler, agent, Galveston, Tex	7,500
Total number of barrels	15,093

All of the above cement was sampled and tested excepting the "Alpha" and "Hemmoor." As this "Alpha" was part of shipment used and tested at mortar battery and was also used on gun battery, and as we had already tested a number of samples of "Hemmoor," it was not thought desirable to run the chances of delaying the batteries by waiting to test these cements, but rather to hold this 1,000 barrels to fill first orders.

Testing apparatus: The plant used in testing the cement is as follows:

1 Fairbanks testing machine, capacity 1,000 pounds.
40 brass molds, standard American Society Civil Engineers.
1 1-pound brass rammer.
2 "Vicat" needles, one-twelfth inch one-quarter pound, and one-twenty-fourth inch 1 pound.
4 galvanized immersion trays, 36 inches by 16 inches by 4 inches.
1 heating lamp and boiler for hot tests.
1 Fairbanks' standard platform scales.
Measures, trowels, thermometers, etc.

Specifications: The specifications governing the acceptance or rejection of the cement are as follows:

While the cement is in the place of storage described above, all facilities for testing it will be given to the United States agent in charge, with the understanding that he shall bring with him all special testing tools and instruments that may be necessary. The use of a telephone will be furnished him free of charge, and I will keep an agent at said storage place to receive and execute all orders that may be given pertaining to delivering the cement. It is also fully understood that whether tested or not no cement will be finally accepted until it has been delivered as ordered at one of the three points above mentioned, and it is also understood that I will be responsible for the cement until such final acceptance.

It is further understood and agreed that the Engineer Officer in charge shall have the right to reject at the start any brand which in his judgment would not be suitable for the work, this absolute right of rejection being for the purpose of saving time and exhaustive tests of any cement that may be considered "under suspicion."

The cement will be stored and delivered in strong barrels, well lined with paper, so as to be reasonably secure from air. No barrel will weigh less than 350 pounds gross, and the average weight per barrel will not be less than 395 pounds. It is understood that broken barrels may be accepted as half barrels at the option of the United States agent in charge.

The cement will be a true Portland, made by calcining a thorough mixture of clayey and calcareous substance, and will not contain more than 2 per cent of sulphuric acid.

It is understood that tests of cement will be made at a temperature of 70° F. or above, and that in making tests samples may be taken from each and every barrel. It is understood that a failure of one-fifth of the samples tested will be sufficient cause for the rejection of all the barrels in the lot from which the samples were taken, and it is also understood that, after molding, the briquets will be kept in moist air for twenty-four hours and then in water until the time of breaking.

The fineness of the cement will be such that at least 75 per cent of it by weight will pass a wire cloth sieve having about 100 meshes per linear inch (holes 0.006 inch square).

When mixed neat with about 20 per cent of water to form a stiff paste, and made into a pat or cake, it will, after thirty minutes in moist air, suffer an appreciable indentation from the end of a wire one-twelfth inch in diameter loaded to weigh one-fourth pound.

When made into a thin cake or pat and immersed in water, after having set in moist air, it will not check, scale, crack, or warp.

Briquets of neat cement will stand a tensile strength of 400 pounds per square inch when seven days old. Briquets made of mortar containing three parts sand to one of cement by weight will stand a tensile stress of 100 pounds per square inch when seven days old, and 150 pounds per square inch when twenty-eight days old. It is understood that the sand used in testing will be such as will be used in actual construction (the San Jacinto sand or similar).

Sampling: The sampling of the barrels of cement was done with an auger, getting the samples from the center of the barrel. The samples, properly marked and inclosed, were taken to the testing room, where they were sifted through a No. 20 sieve to remove all chips, particles of paper, etc., that might have gotten in while getting sample. The samples were then ready for testing.

The following shows the number of barrels sampled and number of briquets made and tested for each sample:

	Barrels sampled.	Briquets made and broken.
"Heyn Bros."	300	55
"Kronsberg"	300	148
"Dyckerhoff"	320	111
"Porta"	600	244
"Kaiser"	301	235
"Lagerdorfer"	1,000	677
Various brands	1	189

The total number of briquets of all kinds made up to the end of June, 1898, was 1,816, thus leaving 224 briquets yet to be broken.

METHOD OF TESTING.

Fineness: Ten ounces from each sample was carefully weighed and sifted through a No. 100 sieve, the amount remaining on sieve being weighed to determine the amount of cement passing sieve. After this determination the sample used was thrown away.

Time of set: Pats of neat cement with about 20 per cent of water were made, one-half inch thick, 3 inches diameter, with thin edges. They were placed on glass under a damp cloth and tested for set with Vicat needles in the usual manner.

Hot test: About two hours after pats had "set hard" they were put in a steam bath at a temperature of 190° F. After being subjected to this bath for about three hours the pats were removed and examined for cracks, swelling, etc. They were then immersed in hot water, temperature 180° F., for three days, and again examined as before.

TESTS FOR TENSILE STRENGTH.

Manipulation: The correct amounts of cement and sand, in the proportions of 1 part of cement to 3 parts of sand, were carefully weighed and thoroughly mixed dry, by hand, on a marble slab. After thoroughly mixing dry, the water, about 12 per cent of the total weight of cement and sand, was added all at once, time noted, and the mass vigorously mixed with trowel for five minutes. The mortar was then tamped into the molds, using a 1-pound brass tamper falling about three-fourths of an inch, the tamping being continued until a film of water appeared upon the face of the briquet. The briquets were then laid away to set under a damp cloth for twenty-four hours, and then immersed in water up to the time of breaking, the water being changed every twenty-four hours.

The amount of tempering water was changed from time to time as the state of the atmosphere and the cement dictated, the object being to get the different mortars of the same consistency.

All the mixing, tempering, and filling of molds was done by hand, thus leaving our results open to the objection that although they agree among themselves, they will hardly agree with results obtained out of the same cement by other parties.

Breaking: All briquets were broken for seven and twenty-eight day tests. The manipulation of the Fairbanks tester is almost entirely mechanical, especial care being taken to have the briquets set squarely in the clips to avoid any twist or side strain being brought upon sample while applying the strain, the rate of application of the weight being about 400 pounds per minute.

With the style of clips furnished with the Fairbanks tester it is quite difficult to avoid side strain or twist, as the bearing surface of jaws of clips is so large that when the weight is applied the briquet is held as in a vise, and no lateral movement can take place. In any future work with this machine I would recommend that the bearing surface of clips be reduced to one-half inch, or even five-sixteenths of an inch, which would allow the surface to adjust itself more or less, and to a large extent prevent the uneven results that are frequently had, and which can be attributed to no other cause than tortion or unequal strain on one side or the other of the sample.

GENERAL REMARKS: The object in our tests was not to establish a standard, but to obtain as even results as possible and to determine whether or not the cement would fulfill the requirements of the specifications as far as our facilities would allow.

As the tempering of the mortar and the manufacture of briquets was done entirely by hand, and as this method of manipulation is open to many objections, especially the fact that the variations in the results of tensile tests between the work of different experienced operators working by same method and upon the same material are frequently very large, the differences of 40 to 60 per cent with neat cement are not uncommon, while for sand mortar they are much greater. (See "Hydraulic cement," by Prof. F. P. Spaulding, and the report of the committee of the American Society of Civil Engineers upon standard cement tests.)

It was our endeavor to make all our tests comparative and parallel. For each batch of one brand mixed a batch of another brand was made up the same day and hour, if possible, under the same conditions; so our results, though they may not compare with tests from other places, should and do agree among themselves.

On account of the above-stated objections, the experience of expert cement men, and my own small experience, I recommend that in any future tests machines for tempering mortar and the manufacture of briquets be purchased.

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Very respectfully, your obedient servant,

S. M. WILCOX,
Assistant Engineer.

Maj. JAMES B. QUINN,
Corps of Engineers, U. S. A.

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4 S.

DEFENSES OF LAKE PORTS IN NEW YORK.

Officers in charge of defenses on Lake Chaplain, Maj. William S. Stanton, Corps of Engineers, until October 1, 1897, and Lieut. Col. Alexander M. Miller, Corps of Engineers, since October 1, 1897; officer in charge of defenses of other lake ports in New York, Maj. William S. Stanton, Corps of Engineers. Division Engineer, Brig. Gen. George L. Gillespie, U. S. Volunteers, Colonel, Corps of Engineers.

Site at Fort Niagara.—The bank of the Niagara River, which is about 40 feet high and has long been slowly caving, was receding too near to the officers' quarters and to the road leading to the fort.

By contract with Michael Bennett, of Sault Ste. Marie, Mich., dated July 7, and approved July 23, a length of 1,850 feet of the bank was sloped and graded and the foot protected with two layers of brush fascines covered with a layer of stone ballast, July 28 to November 24, when the contract was completed. Under the contract 10,714 cubic yards of earth were excavated, and 240 cords of fascines and 594 cords of stone ballast were provided and put in place. This work extended from that part of the bank graded and protected in 1892 to the south boundary of the reservation, and completed the project of 1888. Under the contract about one and one-third acres of the slope were regraded, which had been graded in 1892, and 188 tons of large riprap stones were provided to secure the riprap protection formerly placed near the fort.

By direct hire of labor the surface soil that was available was spread upon the slope, and the entire slope that had been formed and graded under the contract was fertilized and sown with grass seed and winter rye.

It will need careful attention to check washing and gullying, and to be several times refertilized and resown until turf is formed upon it.

The expenditures during the fiscal year ending June 30, 1898, were as follows:

Sloping, grading, and protecting 1,850 linear feet of river bank, under contract	$11,828.14
Fertilizing and sowing bank, including watching and repairing to June 30, 1898, by direct hire of labor	1,276.32
Superindence, surveys, office expenses, and contingencies	1,469.68
Total	14,574.14

Of the foregoing $14,574.14 the sum of $13,000 was defrayed from the appropriation for "Sea Walls and Embankments," and $1,574.14 from the appropriation for "Preservation and Repair of Fortifications."

Money statements.

SEA WALLS AND EMBANKMENTS.

July 1, 1897, balance unexpended	$13,000.00
June 30, 1898, amount expended during fiscal year	13,000.00

PRESERVATION AND REPAIR OF FORTIFICATIONS.

July 1, 1897, balance unexpended		$6,778.81
June 30, 1898, amount expended during fiscal year	$1,574.14	
April 26, 1898, amount withdrawn	3,500.00	
		5,074.14
July 1, 1898, balance unexpended		1,704.67
July 1, 1898, outstanding liabilities		50.00
July 1, 1898, balance available		1,654.67

Fort Montgomery.—To prevent the percolation of water from the terreplein down the joint between the facing and backing of the parade wall into the masonry of the casemate arches, a length of 103 feet was covered with patent granite roofing during the previous fiscal year, as an experiment. It was intended to continue this work during the present fiscal year, but as the experimental work previously done had not proved satisfactory it was recommended that the repairs be deferred

until the alterations of the fort were begun in accordance with the amended plan, as an inspection of the fort developed the fact that much more extensive work would be required than was previously contemplated. In view of the representations made, the Department directed that no further steps be taken for the present to stop the leakage referred to.

The amount expended during the year was $908.57.

It was applied as follows:

To services of fort keeper	$540.00
To mileage, traveling expenses, and services of laborers in refilling trenches previously excavated	368.57

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4 T.

DEFENSES OF SAN DIEGO, CALIFORNIA.

Officer in charge, Maj. Charles E. L. B. Davis, Corps of Engineers; assistants, Lieut. Herbert Deakyne, Corps of Engineers, to January 10, 1898, and Capt. James J. Meyler, Corps of Engineers, since July 3, 1897. Division Engineer, Col. Charles R. Suter, Corps of Engineers.

Ten-inch gun battery—The project for the defense of San Diego includes a battery of 10-inch guns on disappearing carriages. A contract was entered into with the California Construction Company, of San Francisco, Cal., December 19, 1896, for the construction of two of the emplacements, the work to be completed on or before December 31, 1897. At the close of the last fiscal year good progress had been made. For the status of the work at that time and for a general description of plans, method of construction, concrete mixtures, etc., see page 745, Annual Report of the Chief of Engineers, 1897.

On June 17, 1897, a project was submitted for constructing another, or third, emplacement, at an estimated cost of $49,630.22. This estimate was based on the last contract figures obtained for constructing the two emplacements, but it was thought that cheaper figures ought to be received for this new emplacement, as there would be no uncertainty about the availability of the money (at the time of the awarding the last contract no funds were available, and the contractor had to take his own risk about future appropriations being made to permit of uninterrupted payments for work done), and as the contractors were already established there with wharf, water supply, plant, etc. It was therefore recommended that bids be solicited, and that if the lowest exceeded $45,000 all of them be rejected and the work be done by hired labor.

In response to public advertisement ten bids were received, ranging from $37,788.68 to $47,604.88. The California Construction Company, the same firm that were contractors for the first two emplacements, were the lowest bidders, and to them was awarded the contract, the work to be completed on or before January 1, 1898. The same plant was used and no material departures in methods of construction or in the concrete mixtures were made from those pursued under the first contract.

Owing to delays in receiving material from the East the time of completion was extended one month by the Engineer Department and further extended to February 7, 1898, by letter from this office, the work under both contracts being completed on the date last specified.

The foundation of the gun platform in emplacement No. 4 being rather poor, excavation was carried down to a few inches below low water, where a fairly good foundation of clay was found. This excavation was then filled in with sand well tamped in layers of 6 inches, and at the proper reference the concrete commenced. The platform was built as a monolith with a joint between it and the adjoining surfaces, tarred paper being inserted to prevent adhesion, so that if settlement ever takes place the platform will sink vertically by itself.

The defective character of the foundation for the platform was not fully developed until after the concrete of the emplacement and of the traverse between it and emplacement No. 3 was completed, when the great weight of this mass of concrete forced up the bottom of the excavation and pressed up the water in the trial pits. The driving of piles for a foundation would have endangered the concrete already built, as the jarring and shaking in all probability would have seriously cracked it. On the other hand, to have removed all the material down to hard pan would have entailed great expense in shoring up the sides of the excavation. Moreover, either of these methods would have caused the delay incidental to the preparation of specifications for the extra work and the entering into a supplemental contract. So, after careful consideration, the plan described above was adopted, the excavation first being thorougly drained. The total weight of the concrete platform, gun, and carriage is about 516 tons, giving a load per square foot of 1,784 pounds, which is thought to be within safe limits, Baker giving the safe bearing power of soft clay in tons per square foot at 1 ton minimum and 2 tons maximum. Careful levels have been taken and recorded so that future observations will detect any settlement.

After the completion of the contract many small jobs pertaining to the gun battery were done by hired labor, such as ramps and flights of wooden steps connecting terreplein and parade, planting slopes with grass seed, putting up iron ladders in the emplacements for lookouts, chain guards around each gun platform and around stairways leading from gun platform to platform galleries, painting top surfaces of concrete a dark color, and giving a coat of dark-colored wash to all the engineer buildings to render them less conspicuous, putting in water-supply system for the use of the garrison and the battery, etc.

The work of mounting the gun and carriage of each emplacement was completed on the following dates: No. 3, April 9; No. 4, April 29, and No. 2, May 21, 1898. This work was performed by the artillery garrison of San Diego barracks. The carriages traverse very freely, showing careful setting up and also that no settlement has so far taken place.

Money statements.

TWO 10-INCH GUN EMPLACEMENTS.

July 1, 1897, balance unexpended	$64,798.23
June 30, 1898, expended during fiscal year	64,607.38
July 1, 1898, balance unexpended	190.85

ONE 10-INCH GUN EMPLACEMENT.

June 25, 1897, amount allotted	$48,000.00
June 30, 1898, expended during the fiscal year	45,324.42
July 1, 1898, balance unexpended	2,675.58

Mining casemate.—An allotment of $8,030 having been made for the construction of a mining casemate, specifications for it were prepared

and the quantities of material incorporated with those required for constructing the two gun emplacements, bids for both works being solicited and the award of the whole made to one party—in this case the California Construction Company, of San Francisco, Cal.—though the accounts for each class of work were kept separate, as they came under different appropriations.

The work of construction was carried on with that of the gun emplacements and was completed at the same time, viz, February 7, 1898, the extension of time granted covering the contract for the casemate, as well as that of the two emplacements.

Money statement.

July 1, 1897, balance unexpended	$7,841.00
June 30, 1898, expended during fiscal year	7,209.00
July 1, 1898, balance unexpended	632.00

Cable tank.—Under Department instructions, plans and estimates were submitted for the storage of all of the torpedo material required for the submarine mine defense of San Diego, Cal. The plans called for a cable tank and a torpedo storehouse, the respective estimates therefor being $1,700 and $3,840. These plans were approved April 13, 1898, and an allotment of $1,700 made for the cable tank, as the available funds only permitted this.

The first concrete was laid May 20, and the concrete work completed May 28, 1898. The work was done by hired labor, and was completed in June.

Money statement.

April 13, 1898, amount allotted	$1,700.00
June 30, 1898, expended during the fiscal year	1,206.99
July 1, 1898, balance unexpended	493.01

Mining defenses.—Under date of April 22, 1898, directions were received from the Chief of Engineers to at once load and plant any mines at hand at San Diego Harbor, and to complete the system for operating them.

Some material was obtained from Maj. W. H. Heuer, Corps of Engineers, in charge of the torpedo defense of San Francisco Harbor. The officer in local charge, immediately on receipt of instructions, organized a volunteer company of citizens of San Diego, about 80 in number, including carpenters, electricians, civil engineers, surveyors, telegraphers, boiler makers, steam engineers, boatmen, and mechanics. In the meantime a detail of one noncommissioned officer and four enlisted men was sent from the Engineer Battalion.

Work commenced early in May; torpedo cable was purchased in San Francisco; a house built for the oil engine and the dynamo, the casemate not being large enough to contain them; tables, benches, shelves, and fittings were set up in the casemate; signal and firing batteries set up and the latter charged from the transformer; the testing instruments were put in place and telephone communication established between casemate and loading room. Six mines were planted on the 23d and nine more on the 24th, making five triple groups, leaving an open passage marked by regular channel buoys belonging to the United States Light-House Establishment.

On May 20 a notice to mariners was issued and published in the columns of the daily press of the coast notifying them of the discontinuance of the light at Ballast Point and the lights of the lighted channel

beacons in San Diego Bay after May 25, and regulations for navigating the entrance to San Diego Bay in time of war were also published and printed copies of the same widely distributed.

The battery commander has two Napoleon guns trained on the mine fields and a gasoline launch was employed for night patrol purposes until June 22, when the United States revenue cutter *Corwin* arrived at San Diego and took charge of that portion of the coast.

Lieut. J. J. Meyler, Corps of Engineers, has been in local charge of all the work at San Diego, Cal., which he has performed with an intelligence, zeal, and discretion worthy of the greatest praise.

Money statements.

TORPEDOES FOR HARBOR DEFENSE, JANUARY 1, 1899.

June 15, 1898, amount allotted	$6,300.00
June 30, 1898, balance unexpended	6,300.00
June 30, 1898, outstanding liabilities	4,900.00
July 1, 1898, balance available	1,400.00

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

June 16, 1898, amount allotted	$1,500.00
June 30, 1898, expended during fiscal year	339.70
July 1, 1898, balance unexpended	1,160.30

Preservation and repair of fortifications.—The keeper was employed during the year in care of fences and grounds of the reservation and assisting in various ways in construction work about the battery.

Money statement.

July 1, 1897, balance unexpended	$7.15
June 24, 1897, amount allotted	720.00
	727.15
June 30, 1898, amount expended during fiscal year	720.00
July 1, 1898, balance unexpended	7.15

Abstract of bids for constructing one 10-inch gun emplacement, called for by advertisement of July 7, 1897, and opened at 12 m., August 9, 1897, by Maj. Charles E. L. B. Davis, Corps of Engineers, United States Army.

No.	Bidder.	Address.	Amount of bid.
1	City Street Improvement Co	San Francisco, Cal	$47,604.88
2	Rae Building and Contracting Co	do	40,712.40
3	Kimball G. Easton and Arthur R. Wilson	Oakland, Cal	38,655.77
4	W. L. Prather, jr	do	37,799.12
5	California Construction Co	San Francisco, Cal	37,788.68
6	Wm. E. Thornton and Carl Leonardt	Los Angeles, Cal	47,359.62
7	William Osburn	San Diego, Cal	42,179.62
8	Waldo S. Waterman	do	41,913.65
9	Fairchild & Gilmore	Los Angeles, Cal	41,572.97
10	William H. Healy	San Francisco, Cal	38,232.62

NOTE.—The different items of work were bid for separately—excavation, fill, and concrete by the cubic yard; paraffin covering and hard finish by the square yard; steel beams, bolts, wrought-iron work, etc., by the pound; pipe, speaking tube, and tile drain by the foot; lumber by the 1,000 feet; ammunition lifts and cranes at so much a piece; all prices being for materials in place.

4 U.

DEFENSES OF SAN FRANCISCO, CALIFORNIA.

Officer in charge of artillery defense of south side of San Francisco Bay, Col. Charles R. Suter, Corps of Engineers. Officers in charge of artillery defense of north side of San Francisco Bay, Maj. Charles E. L. B. Davis, Corps of Engineers, until January 17, 1898, and Col. Charles R. Suter, Corps of Engineers, since January 17, 1898; Division Engineer, Col. Charles R. Suter, Corps of Engineers, until January 17, 1898. Officers in charge of the torpedo defense of San Francisco and of the artillery defense of the islands in San Francisco Bay, Maj. Charles E. L. B. Davis, Corps of Engineers, until January 14, 1898, and Maj. William H. Heuer, Corps of Engineers, since January 14, 1898; Division Engineer, Col. Charles R. Suter, Corps of Engineers. On April 7, 1898, Major Heuer transferred the works of artillery defense of Angel Island to Colonel Suter, who retained charge to the end of the year. Assistants: Capt. Charles L. Potter, Corps of Engineers, until November 27, 1897; Lieut. Herbert Deakyne, Corps of Engineers, since January 10, 1898; Lieut. Louis C. Wolf, Corps of Engineers, since September 30, 1897; Lieut. Meriwether L. Walker, Corps of Engineers, from May 4 to May 14, 1898, and Capt. Francis R. Shunk, Corps of Engineers, from May 5, 1898.

Gun and mortar batteries on south side of bay.—The principal work of the year has been on emplacements Nos. 9 and 10 for 10-inch guns on United States disappearing carriages, model of 1896, and on Mortar Battery No. 2 for sixteen 12-inch mortars on carriages of model 1896.

The plans for these works had been approved prior to the end of the last fiscal year, and the excavation at Nos. 9 and 10 completed. Forms were built and the concrete mixer set up at these latter emplacements during July, and the heavy concrete work finished by the end of August. Just a month was needed for this work. The gun and loading platforms were built subsequently, and all this work was finished by the middle of October. Back filling was begun September 1, and all the main work was completed by the end of November. Work on minor details—finishing up, ironwork, doors, etc.—was prosecuted during the rest of the season, and by the close of the fiscal year everything was completed except electric lighting. The armament was also installed, and the works turned over to the artillery troops.

At Mortar Battery No. 2 clearing of the site was the only work done before the end of the last fiscal year. As large a force of men and teams were put on the excavation as could be worked to advantage, and all construction work hurried with a view to completing it before the fall rains began. As soon as the pits were clear the platforms, all concrete, were laid. This work, as well as the foundations for the main masonry masses and the detached rooms in end traverses, was built of hand-mixed concrete. October 27 work was begun on the main masses of masonry and was prosecuted with great rapidity. It was practically finished by the end of November. Back filling was begun along the battery as fast as anything was completed. It was begun November 17 and finished February 12. All the base rings were set as fast as received, and the carriages were promptly mounted. Finishing up, hanging doors, etc., took some time to carry out, but the battery was entirely finished and ready for service by the end of the fiscal year, with the exception of electric lighting and the armament of mortars, not yet received.

At the beginning of the year the new emplacements for 12-inch guns, Nos. 8, 18, and 19, were nearly completed. As the armament for the two latter was on hand, they were pushed to completion. Finishing the interior and installing lifts and trolleys was the bulk of the work. When this was completed and the remaining gun mounted, the battery was turned over to the artillery troops. At No. 8 substantially the same work was carried out, but with less haste. The gun has been received, but not the carriage, so that the emplacement is not entirely completed, though all has been done that is possible before the carriage is in place and the gun mounted.

A battery for two 5-inch rapid-fire guns has been ordered for some time, but plans could not be prepared owing to lack of information regarding the carriages. When this information finally became available, plans were sent on and approved, and work was begun. As it is necessary to build the foundation cylinders into the platforms, work could not be carried beyond making the excavation, laying the foundations, and completing some portions of the battery. This work was done in March, and remains in statu quo, the carriages not having been received.

In addition to the new work here enumerated, minor operations have been in progress on all the old emplacements, with the intention of supplying means of service not contemplated in their original construction. For the three 12-inch guns Nos. 14, 15, and 16 a guard and relocator room, begun last year, has been completed. It is connected by voice pipes with all three emplacements. Similar rooms, with lookout and other accommodations, have been built for the service of the 10-inch guns in emplacements Nos. 11, 12, and 13. It is located in the space between Nos. 12 and 13. The relocator room in emplacements Nos. 9 and 10 has been also connected with No. 11 as an additional precaution. Similar rooms were also built for Mortar Battery No. 1, where the accommodation proved inadequate, and speaking tubes connect these rooms with the different pits. Cranes, stairs, railings, and trolleys, which had been delayed pending the mounting of the guns, were also supplied to the older 10-inch emplacements Nos. 11, 12, and 13.

Finally, much work was done in surveys about the batteries, establishing base lines and determining azimuths, elevations, etc., for the use of the artillery garrison. All the guns and mortars mounted have been oriented prior to the graduation and marking of the azimuth circles by the Ordnance Department.

The work connected with the water supply of the batteries was completed by the installation of an electrical indicator connected with the pumping house.

The report of Lieutenant Wolf, copy appended, is referred to for further details concerning all these operations.

During the year there have been received one 12-inch gun, three 10-inch guns, three 10-inch gun carriages, and 16 mortar carriages. All have been mounted except one 12-inch gun, which has no carriage.

Lieutenant Potter was in immediate charge of this work until relieved December 1 by Lieutenant Wolf. Both of these officers have rendered most valuable and efficient service.

Gun batteries on north side of bay and on islands in bay.—The battery for three 12-inch rifles was completed so far as authorized, the terrepleins having been graded and concreted and the last gun mounted in September, but the possibility of an attack and the isolated position of the battery rendered some precautionary measures a necessity. The entire battery and the covered way leading back to the main road were surrounded with barbed-wire entanglements and a stockade built across

the end of the covered way. It was hoped that these measures might enable the guard to stand off an attack till help could reach them from the troops quartered below; but considerable work will be needed to place this battery in an efficient condition. Various rooms must be built for fire-control service, for guard rooms, and for defense against a land attack. Some machine guns should also be supplied for the latter purpose.

A tank sunk in the ground was built on the hill above the battery and connected therewith. The tank is supplied by a pump located near the quarters.

The lifts were slightly altered so as to admit the ammunition trucks which the Ordnance Department proposes to furnish. At present there is no way of handling ammunition either at this battery or at the five similar emplacements on the south side of the bay.

On March 17 directions were given by telegraph to construct two emplacements for 8-inch B. L. rifles on nondisappearing carriages on the mainland and one for similar armament on an island in the bay with funds allotted from the appropriation for "National Defense," act of March 9, 1898.

Further instructions directed the use of all possible dispatch in carrying this work to completion. Lieutenant Deakyne was placed in charge, and after surveys of the ground had been made and plans prepared work was commenced on the mainland. The battery was arranged to straddle the ridge and face toward the south, thus giving the most advantageous field of fire. The peculiar situation enabled the magazines, etc., to be held at the level of the terrepleins, so that no lifts are required, and the service of the guns should be very rapid. Some time was consumed in building roads, arranging pumping plant, and accumulating supplies. Excavation began April 9, and was prosecuted night and day, with two 8-hour shifts. Concreting began April 24, and was mainly completed by May 12. No night work was done on concrete work, as the necessary stone supply could not be kept up. Building the two platforms took from May 11 to 14. Much grading was required in trimming off the ridge in front of the battery, and at the end of June there was still a month's work on hand to entirely complete the work. No guns or carriages have been received. A tank has been sunk in the ridge behind and above the battery for water supply. This tank is filled by an oil engine and pump from a well in the plain below. The site of the battery was occupied by a soft red rock, and all the excavation was in this material. This has retarded the work somewhat, but the rate of work has been satisfactory and the whole operation very creditable to Lieutenant Deakyne.

Before beginning work on the island it was necessary to build quarters and stables, repair wharf and roads, set up rock crusher, and do other things which consumed much time. During this preliminary work, from April 1 to 20, Lieutenant Deakyne was in charge, but about that time the completion of the work on the south side of bay enabled Lieutenant Wolf to be sent to the island, so that Lieutenant Deakyne could confine his attention to the mainland.

Excavation was begun April 23 and ended May 13, the work being, as on the mainland, in two eight-hour shifts. Much rock was encountered, especially about the gun emplacement proper. The general type of work adopted was similar to the emplacements on the mainland. Owing to the small amount of work, the concrete used was mixed by hand. Concreting began on May 16 and was finished May 30, seven days having been lost while waiting for an additional allotment.

A sunken tank was built in the hill back of the battery for the water supply. It is filled by a branch from one of the main pipe lines running to the garrison waterworks.

The entire work was completed June 20, so far as can be done until the carriage is received. As there was less excavation here than on the mainland the work was done more rapidly, but both Lieutenants Deakyne and Wolf are entitled to great credit for their zeal and efficiency in pushing this emergency work.

Lieutenant Shunk reported for duty while the work on the mainland was in progress, but under the general instructions to assist in laying mines he was turned over to Major Heuer, and has been on duty with him ever since.

A copy of Lieutenant Wolf's report on the island work is inclosed for details. The work on the mainland not being completed, the itemized cost statement has been withheld for the present.

Allotments.

WORKS ON SOUTH SIDE OF BAY.

Gun and mortar batteries.

Emplacements, etc.:		
September 11, 1890 (act August 18, 1890)		$100,000.00
March 10, 1891 (act August 18, 1890)		101,000.00
July 2, 1891, cement (act February 24, 1891)		15,000.00
September 19, 1891, cement (act February 24, 1891)		10, 00.00
November 9, 1891, cement (act February 24, 1891)		5,000.00
December 4, 1891, cement (act February 24, 1891)		5,000.00
December 23, 1891, cement (act February 24, 1891)		5,000.00
January 20, 1892, cement (act February 24, 1891)		10,000.00
February 17, 1892—		
Act August 18, 1890	$59,000.00	
Act February 24, 1891	87,332.00	
		146,332.00
		397,332.00
February 4, 1893, transferred to Mortar Battery No. 1—		
Act August 18, 1890	$45,000.00	
Act February 24, 1891	70,118.50	
June 8, 1896, transferred to Mortar Battery No. 1 (act August 18, 1890)	1,500.00	
October 5, 1893, withdrawn (act February 24, 1891)	10,500.00	
March 3, 1894, withdrawn (act February 24, 1891)	3,600.00	
		130,718.50
Balance		266,613.50
Gun platforms, etc. (10-inch guns, emplacements 11, 12, 13):		
May 28, 1895 (act August 1, 1894)		5,000.00
June 15, 1895 (act March 2, 1895)		8,838.00
November 15, 1895, transferred from mortar platforms (act August 1, 1894)		2,150.22
Total		15,988.22
Gun platforms, etc. (12-inch guns, emplacements 14, 15):		
December 14, 1895 (act August 1, 1894)	$4,627.55	
December 14, 1895 (act March 2, 1895)	972.45	
		5,600.00
September 15, 1896, transferred to platform of emplacement No. 8 (act March 2, 1895)	$691.90	
November 20, 1896, transferred to Mortar Battery No. 1 (act March 2, 1895)	125.00	
		816.90
Balance		4,783.10

Gun platform, etc. (12-inch gun, emplacement 16):		
September 29, 1894 (act August 1, 1894)		$4,000.00
November 15, 1895, withdrawn		1,101.57
Balance		2,898.43
Mortar Battery No. 1:		
February 4, 1893, transferred from emplacements, etc.—		
Act August 18, 1890	$45,000.00	
Act February 24, 1891	70,118.50	
		$115,118.50
June 8, 1896, transferred from emplacements, etc. (act August 18, 1890)		1,500.00
November 20, 1896, transferred from 12-inch gun platforms, emplacements 14, 15 (act March 2, 1895)		125.00
November 20, 1896, transferred from emplacements, etc. (act June 6, 1896)		275.00
November 10, 1897, transferred from emplacements, etc. (act June 6, 1896)		2,500.00
		119,518.50
December 31, 1895, withdrawn (act February 24, 1891)		5,118.50
Balance		114,400.00
Mortar platforms, etc.:		
March 14, 1893 (act February 18, 1893)		$10,000.00
September 5, 1894 (act August 1, 1894)		25,641.00
		35,641.00
November 15, 1895, withdrawn (act August 1, 1894)	$3,525.98	
November 15, 1895, transferred to 10-inch gun platforms, Emplacements 11, 12, 13 (act August 1, 1894)	2,150.22	
		5,676.20
Balance		29,964.80
Emplacements, etc.:		
July 3, 1896 (act June 6, 1896)		$168,000.00
September 15, 1896, transferred from 12-inch gun platforms, emplacements 14, 15 (act March 2, 1895)		691.90
		168,691.90
November 20, 1896, transferred to Mortar Battery No. 1 (act June 6, 1896)	$275.00	
February 11, 1897, transferred to water supply (act June 6, 1896)	9,300.00	
July 21, 1897, transferred to water supply (act June 6, 1896)	700.00	
November 10, 1897, transferred to Mortar Battery No. 1 (act June 6, 1896)	2,500.00	
December 18, 1897, transferred to Mortar Battery No. 2	12,000.00	
February 9, 1898, transferred to Mortar Battery No. 2	6,500.00	
December 16, 1896, withdrawn (act June 6, 1896)	12,000.00	
		43,275.00
Balance		125,416.90
Water supply for defensive works:		
February 11, 1897, transferred from emplacements, etc. (act June 6, 1896)		$9,300.00
July 21, 1897, transferred from emplacements, etc. (act June 6, 1896)		700.00
Total		10,000.00
Emplacements 9 and 10:		
May 25, 1897 (act March 3, 1897)		$57,000.00

Mortar Battery No. 2:		
June 14, 1897 (act March 3, 1897)		$108,000.00
December 18, 1897, transferred from emplacements, etc. (act June 6, 1896)		12,000.00
February 9, 1898, transferred from emplacements, etc. (act June 6, 1896)		6,500.00
Total		126,500.00
Shelter for Lewis range finder:		
December 17, 1896 (act March 2, 1895)		$280.00

WORKS ON NORTH SIDE OF BAY.

Gun and mortar batteries.

Emplacements 3, 4, and 5:		
November 9, 1892 (act July 23, 1892)		$72,000.00
March 8, 1895 (act August 1, 1894)		20,000.00
March 28, 1895—		
Act August 1, 1894	$7,400.00	
Act March 2, 1895	9,361.29	
		16,761.29
		108,761.29
June 2, 1894, withdrawn (act July 23, 1892)		2,800.00
Balance		105,961.29
Gun platforms, emplacements 3, 4, and 5:		
December 14, 1895 (act March 2, 1895)		$8,400.00
June 18, 1896, withdrawn		3,900.00
Balance		4,500.00
12-inch battery:		
May 6, 1898 (act March 3, 1897)		$2,000.00

Money statements.

WORKS ON SOUTH SIDE OF BAY.

Gun and mortar batteries.

Emplacements, etc.:	
July 1, 1897, balance unexpended	$57.47
June 30, 1898, amount expended during fiscal year	57.47
Gun platforms, etc. (10-inch guns, emplacements 11, 12, 13):	
July 1, 1897, balance unexpended	$611.72
July 1, 1898, balance unexpended	611.72
Mortar Battery No. 1:	
July 1, 1897, balance unexpended	$99.36
November 10, 1897, transferred from emplacements, etc. (act June 6, 1896)	2,500.00
	2,599.36
June 30, 1898, amount expended during fiscal year	2,142.31
July 1, 1898, balance unexpended	457.05

Emplacements, etc.:		
July 1, 1897, balance unexpended		$57,181.24
July 21, 1897, transferred to water supply	$700.00	
November 10, 1897, transferred to Mortar Battery No. 1	2,500.00	
December 18, 1897, transferred to Mortar Battery No. 2 } February 9, 1898, transferred to Mortar Battery No. 2	18,500.00	
		21,700.00
		35,481.24
June 30, 1898, amount expended during fiscal year		30,957.35
July 1, 1898, balance unexpended		4,523.89
July 1, 1898, outstanding liabilities		751.94
July 1, 1898, balance available		3,771.95
Emplacements 9 and 10:		
July 1, 1897, balance unexpended		$56,251.65
June 30, 1898, amount expended during fiscal year		54,371.12
July 1, 1898, balance unexpended		1,880.53
July 1, 1898, outstanding liabilities		249.28
July 1, 1898, balance available		1,631.25
Mortar Battery No. 2:		
July 1, 1897, balance unexpended		$108,000.00
December 18, 1897, transferred from emplacements, etc.	$12,000.00	
February 9, 1898, transferred from emplacements, etc.	6,500.00	
		18,500.00
		126,500.00
June 30, 1898, amount expended during fiscal year		126,346.22
July 1, 1898, balance unexpended		153.78
July 1, 1898, outstanding liabilities		2.00
July 1, 1898, balance available		151.78
Water supply for defensive works:		
July 1, 1897, balance unexpended		$274.93
July 21, 1897, transferred from emplacements, etc		700.00
		974.93
June 30, 1898, amount expended during fiscal year		953.25
July 1, 1898, balance unexpended		21.68
July 1, 1898, outstanding liabilities		20.00
July 1, 1898, balance available		1.68
Shelter for Lewis range finder:		
July 1, 1897, balance unexpended		$5.35
June 30, 1898, amount expended during fiscal year		5.35

WORKS ON NORTH SIDE OF BAY.

Gun and mortar batteries.

Emplacements 3, 4, and 5:		
July 1, 1897, balance unexpended		$3,620.56
June 30, 1898, amount expended during fiscal year		3,620.56
Gun platforms, emplacements 3, 4, and 5:		
July 1, 1897, balance unexpended		$555.87
June 30, 1898, amount expended during fiscal year		447.28
July 1, 1898, balance unexpended		108.59

Twelve-inch battery:		
May 6, 1898, allotment		$2,000.00
June 30, 1898, amount expended during fiscal year		464.50
July 1, 1898, balance unexpended		1,535.50
July 1, 1898, outstanding liabilities	$557.59	
July 1, 1898, amount covered by uncompleted contracts	52.00	
		609.59
July 1, 1898, balance available		925.91

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

Two 8-inch gun emplacements.

March 18, 1898, amount allotted	$50,000	
May 23, 1898, amount allotted	5,000	
		$55,000.00
June 30, 1898, transferred to island in bay		1,500.00
		53,500.00
June 30, 1898, amount expended to end of fiscal year		41,959.24
July 1, 1898, balance unexpended		11,540.76
July 1, 1898, outstanding liabilities		6,995.39
July 1, 1898, balance available		4,545.37

One 8-inch gun emplacement on island in bay.

March 18, 1898, amount allotted	$25,000.00	
May 23, 1898, amount allotted	6,000.00	
		$31,000.00
June 30, 1898, transferred from 8-inch gun emplacements		1,500,00
		32,500.00
June 30, 1898, amount expended to end of fiscal year		30,173.44
July 1, 1898, balance unexpended		2,326.56
July 1, 1898, outstanding liabilities		2,326.56

Preservation and repair of fortifications.—Under this appropriation the routine work of care of engineer quarters and public property was carried on at works on both sides of the bay, mainly by fort keepers.

At one work on the south side of the bay four platforms for 8-inch converted rifles were completed and armed, and under authority from the Department the construction of ten others was commenced. These are mainly intended to cover the mine fields. Three have been built on the north side of the bay, and three on an island in the bay. Two are to be built at another work on the south side of the bay, and two others on another island in the bay. On the island the old timber magazine has been repaired, but that at the site of the two on the south side of the bay is past remedy, and will be replaced by a light concrete structure.

Money statements.

PRESERVATION AND REPAIR OF FORTIFICATIONS.

Works on south side of bay.

July 1, 1897, balance unexpended	$1,909.50
June 30, 1898, amount expended during fiscal year	1,368.98
July 1, 1898, balance unexpended	540.52

Fort Mason.

July 1, 1897, balance unexpended	$24.59
June 30, 1898, amount expended during fiscal year	21.75
July 1, 1898, balance unexpended	2.84

Works on north side of bay.

July 1, 1897, balance unexpended	$766.42
June 24, 1897, allotted	1,380.00
	2,146.42
June 30, 1898, amount expended during fiscal year	1,627.08
July 1, 1898, balance unexpended	519.34
July 1, 1898, outstanding liabilities	48.00
July 1, 1898, balance available	471.34

Platforms for four 8-inch rifles, south side of bay.

July 1, 1897, balance unexpended	$635.39
June 30, 1898, amount expended during fiscal year	176.40
July 1, 1898, balance unexpended	458.99

Ten platforms for 8-inch rifles, San Francisco Harbor, California.

April 8, 1898, allotted	$3,700.00
June 30, 1898, amount expended during fiscal year	738.75
July 1, 1898, balance unexpended	2,961.25
July 1, 1898, outstanding liabilities	711.25
July 1, 1898, balance available	2,250.00

REPORTS OF ADDITIONAL SECOND LIEUT. LOUIS C. WOLF, CORPS OF ENGINEERS.

GUN AND MORTAR BATTERIES.

UNITED STATES ENGINEER OFFICE,
San Francisco, Cal., June 30, 1898.

COLONEL: I have the honor to submit the following report of operations on the defenses of San Francisco Harbor under your charge during the fiscal year ending June 30, 1898. The work done was under the immediate supervision of Lieut. C. L. Potter until December 1, 1897, since which time it has been under mine.

PRESERVATION AND REPAIR OF FORTIFICATIONS.

Works on south side of bay.—No work was done during the year.

Fort Mason.—No work was done during the year except to build a fence on east side of reservation.

A fort keeper has been employed during the year in charge of property and of minor repairs to the work, assisted as required by hired labor. The total amount of expenditures under this appropriation was $918.75, as follows:

Pay of fort keeper, 12 months, at $65 per month	$780.00
Weeding of slopes	23.00
Policing of batteries	82.00
Repair of buildings, fence, and waterworks	12.00
For fence at Fort Mason	21.75
Total	918.75

Platforms for four 8-inch rifles, south side of bay.—The work remaining unfinished at the end of last fiscal year was completed, $92 being expended.

Platforms for 8-inch converted rifles, on island in bay.—Three platforms for 8-inch converted rifles were built, and the old timber magazine repaired, involving the expenditure of $939.

GUN AND MORTAR BATTERIES.

Shelter for Lewis range finder.—A gossamer-cloth cover for range finder was provided, at a cost of $5.35, exhausting the appropriation.

Water supply for defensive works.—A concrete pavement was placed around the piers which support the tank at the dynamite battery, the tank was painted and roofed over, and necessary pipe connections made, all at an expense of $155.72.

The installation, by contract, of an electrical indicator in the quartermaster's pumping station to indicate depth of water in reservoirs at Rob Hill involved an expenditure of $356, making a total expenditure on water supply of $511.72.

* * * * * * *

Mortar battery No. 1.—The firing room which had been built in the battery not being sufficiently large to provide room for charts, relocator, etc., an addition was built to it for commanding officer's, guard, telephone, and chart rooms, the firing room being now used as a relocator room. Excavation was commenced on this addition November 22, and the main work completed by the end of January. A considerable portion of rock was encountered in excavating. The concrete retaining walls forming entrance to firing room had to be removed, and light blasting was resorted to with good effect. The effect of the shot was not at all extended to the main walls of the building. Speaking tubes had not been provided between the mortar pits and magazines, nor between commanding officer's room and mortar pits; these were put in at a cost of $332.85. Certain minor expenditures also were made.

Statement of expenditures.

Relocator room, etc.:	
Excavation, 460 cubic yards, at 70 cents	$322.00
Backfill and repair of slopes, 210 cubic yards, at 36.7 cents	75.00
Forms	236.26
Concrete work, 177 cubic yards, at $4.62	817.01
Floor, top finish	65.72
I-beams, 4,180 pounds, at 2¼ cents	94.05
Plastering and pointing of walls	129.04
30 gallons paraffine paint	33.00
Whitewashing	82.00
Doors	174.91
Doors, steps, etc	30.00
Total	2,058.99
Mortar battery proper:	
Speaking tubes	332.85
Repair and adjustment of trolleys and triplex blocks	66.52
Racks for sponge and rammer staffs	21.50
Additions and alterations to firing boxes and connections	34.65
Tools and repairs to water works, etc	23.08
Tota	2,537.59

Emplacements 9 and 10.—These emplacements are for 10-inch disappearing guns, center-pintle carriages, model 1896, and are complete throughout. Two carriages and guns are mounted. For some reason not yet understood, carriage No. 29, Emplacement No. 9, can be traversed over only a portion of arc. The matter has been investigated, but up to the present time no remedy has been found. It is probable that the gun and carriage must be raised from the lower roller path in order to remedy the defect.

Work was commenced on these emplacements about the 10th of June, 1897, and the excavation completed by the end of the month. The material encountered in the excavation was loam and clay. The ground was loosened by plowing and the material removed by carts and used in the construction of parapets.

The framework for the concrete mixer and approaches thereto were also partly erected during the month of June. On the 6th of July the foundation was finished, the concrete being made by hand. By the 28th of July the forms for magazines, etc., had been completed and the bridging for concrete mixer had been put up. The making of concrete by machine was commenced on that day. In spite of the fact that the lack of room on the bridge of the concrete plant prevented the material from being handled as expeditiously as it otherwise could have been, the daily consumption of cement was in excess of that on the works at emplacements 8, 18, and 19, having risen from an average of 95 barrels on these latter to 110 barrels. On the 28th of August the rough concrete work of the magazines, etc., was completed. A total of 4,446 yards of concrete was used in the magazine building. In addition, 254 cubic yards of rubble rock and 30 cubic yards of old concrete, obtained from the maga-

zines and old breast walls that occupied the site of the emplacements, were embedded in the walls. The erection of forms for loading platform at No. 9 was commenced August 30. Both loading platforms and gun platforms were completed by the 19th of October. A total of 1,057 cubic yards of concrete was used on this part of the work. The concrete stairs leading to loading platforms required 120 cubic yards of concrete. Backfilling over magazine commenced September 1, and was continued, when not interrupted by the laying of concrete for loading gun platforms, until completed. By the end of November the main work was finished, leaving only such work as the pointing of interior walls, laying of floors, and hanging of doors. Owing to the large amount of blacksmith's work necessary on doors and the fact that the blacksmith was kept very busy on other more pressing work, it was some time before the doors were finally finished. The base rings of the two carriages were set in December, and a detachment from the various garrisons in the harbor were soon engaged mounting the carriages. The guns were mounted by the end of March, some delay having occurred in their shipment to this place.

The following is a statement of expenditures made from allotment for emplacements 9 and 10:

Excavation, 4,910 cubic yards, at 42½ cents (*a*)	$2,085.12
Concrete plant, $415.02 (*a*), $941.78	1,356.80
Six mining cars and turntable	506.00
Forms for magazines and gun platforms	3,957.95
Concrete work, 5,632 cubic yards, at $5.23	29,437.60
Taking down forms and mixer	554.58
Plastering, paraffine painting, and pointing walls	885.99
Painting I-beams, whitewashing, and cement washing	225.00
Top finish of floors	750.13
Tools, supplies, etc	181.13
Gun aprons	508.20
Cement testing	302.20
Asphalt covering	677.85
Making survey	225.00
Backfill, $60 (*a*), and top dressing, $2,104.50	2,164.50
Drains, sewers, and grates	276.11
Road excavation and macadam	904.65
Gutter	209.84
Repair of McDowell avenue	668.30
Iron ladder	6.33
Wooden stairs	151.43
Doors	1,856.36
Latrine	167.82
Setting base rings	100.00
Triplex blocks	263.90
Shot trolleys	375.87
Cranes	219.60
Speaking tubes	61.19
Water system	64.51
Sharpening tools	202.17
Repair of carts and wagons	104.46
Stables	1,473.24
Hand rails	131.04
Policing	171.75
Holidays	33.00
Field office	1,262.00
Town office	941.88
Office expenses (*a*)	475.00
Tools and materials (smithy)	158.30
Sundries	229.84
I-beams (*a*)	968.65
Forage, shoeing, and repairs (*a*)	109.21
Rubble rock	298.00
Total	55,702.50
Less amount paid last fiscal year	15,826.69
	39,875.81

All items marked (*a*) were paid for during last fiscal year.

Emplacement No. 8.—This emplacement is for one 12-inch rifle, disappearing carriage.

At the end of last fiscal year the main part of the work had been completed, only certain minor work being yet unfinished. At this time work was commenced elsewhere

where on a large scale, and since it was considered necessary to take advantage of the season to push the latter work to completion, only a comparatively small number of men were engaged on emplacement 8. The remark made above relative to the hanging of doors also applies to this emplacement. The work was finished then mainly as opportunity afforded. It is completed now, except that the base ring has not been set, the carriage having not yet been received. The rifle has been on hand since March, and was placed immediately behind the emplacement, convenient for mounting. The following is a statement of expenditures for this emplacement:

Balance of backfill, grading, sodding, etc	$224.00
Apron	235.90
Concrete stairs	94.45
Pointing and hard finish	237.00
Macadamizing road and terreplein	169.65
Sumps and gutters	37.25
Urinal	26.00
Ammunition trolleys and cranes	230.00
Moving rifle (contract)	300.00
Iron ladder	20.00
Doors remaining unfinished	11.30
Handrails	64.86
Total	1,650.41

Emplacements Nos. 11, 12, 13.—The excavation for guard and relocator room was commenced October 1, 1897. By the end of the month it had been completed and the foundation for the rooms laid. The excavation amounted to 680 cubic yards. During the following month, and until December 15, the carpenters were engaged, as other work permitted, on the construction of forms for the rooms. On the latter date, concreting was commenced and pushed to completion as quickly as possible, 271 cubic yards being put in place. The engineering work was completed by the end of January, except such minor items as whitewashing and hanging of doors. The foundation and sewer connections for latrine were laid in February, and by the end of March all work had been completed. The latrine is intended for use of officers and detachments belonging to emplacements 11–13. A lookout above the relocator room was also built.

Shot trolleys and cranes were provided for these emplacements, as also iron stairs leading to loading platforms from the road in rear. The macadamized terrepleins were replaced by concrete pavements.

Statement of expenditures.

Guard and relocator room:		
Excavation, 680 cubic yards, at 72 cents	$490.00	
Forms (old lumber)	233.25	
Concrete work	872.10	
I-beams	151.34	
Teams	149.75	
Back filling, 500 cubic yards, at 87.8 cents; sodding and top-dressing	439.25	
Plastering and pointing	113.00	
Top finish, floor	32.00	
Doors, including setting of same	198.28	
		$2,678.97
Lookout, concrete work		359.53
Latrine and sewer		333.86
Total		3,372.36
Emplacements Nos. 11, 12, 13, proper:		
Whitewashing magazines		$105.50
Manhole covers		11.17
Iron stairs		642.00
Shot trolleys		269.38
Shot cranes		602.73
Telephone board		4.00
Concrete pavement on terreplein		1,143.18
Wooden stairs		331.61
Speaking tubes		206.41
Miscellaneous small repairs		36.77
Handrails		194.58
Total		6,919.69

Emplacements Nos. 14, 15, 16.—The excavation for guard and relocator room, emplacement No. 14, had been completed at the end of the last fiscal year. The forms were put up early in July, concreting being commenced on the 7th and finished on the 10th of July. The concrete laid in these rooms was 194 cubic yards; in the stairs leading to lookout, 22 cubic yards. Only the work of finishing floors and hard-finishing walls and hanging doors remained at the end of the month.

Statement of expenditures.

Guard and relocator room:		
Forms	$175.59	
Concreting	885.21	
Plastering walls	39.50	
Hard-finishing walls	51.00	
Top-finish of floors	30.00	
Back fill and repair of slopes	142.00	
Setting hinges, etc	26.00	
Concrete stairs, 74	74.00	
Doors	138.90	
		$1,562.20
Emplacements Nos. 14, 15, and 16, proper:		
Whitewashing magazines		68.00
Repair of waterworks		15.45
Alterations to ammunition lifts		88.00
Speaking tubes		206.40
Miscellaneous small repairs		36.77
Wooden stairs		33.16
Total		2,009.98

Emplacements 18 and 19.—At the end of last fiscal year these emplacements were nearly finished, the remaining unfinished work being concrete pavement of terre-pleins, fencing battery, hanging doors, installing lifts and trolleys, and asphalting roof of magazines and top of parapet. All this work was done, and besides a latrine was built, the interior walls were hard-finished, aprons built, and certain minor operations carried on. Practically all work was completed by the end of August. Considerable difficulty was experienced in locating a leak which occurred in passageway to No. 19. It is probable that the roof of the passage was cracked by the 12-inch rifle of No. 18 being hauled across, and the leak resulted in this way. This leak has now been remedied. It is the only one that has occurred in the works at this place within the last two years.

Statement of expenditures (emplacements Nos. 18 and 19).

Latrine	$138.52
Concrete paving of terreplein and stairs	613.47
Macadamizing ramp, etc	158.25
Setting doors	68.00
Fence	107.50
Hard-finish of walls	358.00
Aprons	816.27
Road to dynamite battery	20.00
Asphalting	1,724.91
Ammunition lifts	912.50
Ammunition carriers	385.63
Powder truck	19.03
Doors	508.15
Miscellaneous small repairs	36.77
Wooden stairs	33.16
Total	5,900.16

Rapid-firing battery.—Excavation was commenced on the 16th of March; by the end of the month it had been completed. The foundation throughout the battery has been laid and the concrete work on relocator and entrance to old magazine completed. The road also in rear was cut and graded. At this point no more work could be done because of the nonarrival of the cylinders to pivot the guns. These must be set in the concrete, and no further work can be done until they are received.

Statement of expenditures.

Excavation, 859 cubic yards, at 68 cents		$588.05
Forms, labor, and material		412.26
722 barrels cement, at $2.44		1,776.32
Concrete work, labor only, as far as done, 270 cubic yards		546.00
Material:		
Rock	$1,493 60	
I-beams	210.51	
Ringbolts	20.50	
Hinges and hasps	27.22	
		1,751.83
Plastering		46.00
Top-finishing floors		38.00
Macadamizing road		67.00
Drains and gutters		92.64
Water supply		12.00
Back fill, as far as completed		71.50
Stables, labor, and forage		621.71
Speaking tubes		7.00
Removal of blacksmith shop		119.00
Material, blacksmith shop		6.00
Field office		530.00
Town office		310.00
Total		6,995.31

Mortar Battery No. 2.—The site of the battery had been cleared and the work had been laid out at the end of the last fiscal year. On July 1 preliminary work, such as the building of roads, etc., was commenced. This was continued until July 6, on which day excavation was started. The work of excavation was carried on until the end of October. The main part of excavation was in sand, but near the bottom of the cut a stratum of clay was met. This consisted of a heavy dark blue, almost black, material, exceedingly difficult to work; in fact, it was found possible to work it only by cutting it out with mattocks and axes. The stratum reached a height of about 10 feet above the foundation at the right end of magazine No. 1, and from that height sloped gradually, running to nothing at the front and left of battery foundation. A small amount of rock, too, was met with in the excavation for guardroom No. 1. It is probable that the actual amount of material was far in excess of the estimate, because of the fact that the sand would stand at only a very gradual slope, necessitating the removal of a great amount not originally reckoned upon. This fact, together with a very long and high haul of material, resulting from the extremely large quantity of earth to be handled, made the cost of excavation larger than estimated.

In September the excavation had progressed so far that the foundations for the magazine buildings could be laid. In the meantime the construction of framework for magazines and passages was going on. The concrete work on platforms of pit No. 4 was finished during September. In October platforms of pits 1 and 2 were constructed, as was also guardroom No. 4. In this month the first base ring was set in pit No. 1. The concrete put in up to this time was all hand mixed. By the 27th the forms for magazines 3 and 4 were up, the concrete mixer and approaches thereto were completed, and the making of concrete by machine commenced on that day. The plant was probably more perfectly installed than it had ever been before on the works here. This was possible without incurring great expense, mainly because of the great height that the mound resulting from excavation reached. The road that had been used in excavating was somewhat improved, so that the material to be used could easily be hauled over it to the mixer. This latter occupied a position between the site of the battery and the mound resulting from material excavated. From the road above referred to it was then necessary to construct approaches to the mixer. The additional height enabled the use of a gravity supply throughout in furnishing material to the mixer. The largest number of barrels of cement ever used before in one day of eight hours was 114; on this work it reached 200, and the average number per day during all the time the mixer was in continuous operation was only three or four less. The concrete work on magazines 3 and 4 was finished November 6; on the 10th the forms for magazines 1 and 2 were up and concreting was commenced, being completed on the 19th. The mortar platforms of pit No. 3 and guardroom No. 4 were built during the month, handmade concrete being used. The retaining walls around the pits were built as quickly as the forms could be put up. The setting of base rings was continued as they were received.

On the 26th of November the forms for the administration building were up and by the end of the month nearly all the concrete was in.

On the 17th back filling was commenced over the guardrooms at the ends of the battery and continued until completed. In the meantime the mixing plant was

taken down and back fill over magazines and administration building begun. This was not completed until February 12, 1898. The fact that the amount of money expended on back fill, notwithstanding its being done in the most approved method, exceeded the estimate, confirms the statement that the excavation was far in excess of the estimated amount. The 12th of February then marks the date of the practical completion of Mortar Battery No. 2. All work that remained after that date was that of finishing up, and this was done as expeditiously as the conditions permitted. The sewerage system of the battery is complete in every respect. Two large latrines for the enlisted men and one for the officers are provided. The total amount of concrete put in by machine was 9,543 cubic yards. The last base ring was set in March. The carriages, except the first, were mounted by the artillery, except such assistance as the Engineer Department rendered in hauling the parts to the mortar pits. No mortars have yet been received.

Statement of expenditures.

Excavation, 43,500 yards, at 51 cents	$22,411.91
Back fill, 45,850 cubic yards, at 23 cents	10,545.13
Sodding and top-dressing	3,255.95
Forms, labor, $3,846.21; material, $2,891.87	6,738.08
Concrete work, 9,920 cubic yards, at $4.28	42,457.39
I-beams, bolts, and eyebolts	5,232.39
Ventilators, flue lining	294.81
Drains, sumps and grates	1,807.48
Plastering, pointing, and whitewashing walls	2,751.00
Paraffine painting walls	854.31
Top finish of sidewalks and terreplein	874.75
Top finish of floors	1,120.52
Hard finish of administration building	103.00
Taking down forms	988.25
Taking down concrete plant	281.00
Roads, labor, macadam, etc	5,140.87
Setting base rings	603.50
Trolleys	2,246.56
Speaking tubes	237.18
Latrines	779.44
Doors	2,201.19
Buildings, smithy, etc	231.04
Wooden stairs	89.12
Water supply	357.68
Repair of carts and wagons	596.74
Shoeing horses	978.31
Stables, forage, supplies, and labor	4,564.21
Cement testing	229.00
Policing	411.50
Survey and mapping of fortifications	1,138.00
Holidays	2,063.00
Field office	1,956.00
Town office	1,665.06
Materials, tools, etc	336.35
Sundries	285.01
Moving and mounting carriages	192.00
Firing boxes	113.13
Handrails	64.86
Total	126,195.72
General charges:	
Stables	1,446.57
Repairs to fences	225.75
Repair to McDowell avenue	301.00
Surveys, mapping of fortifcations	386.17
Cement testing	78.00
Field office	480.00
Town office	658.10
Miscellaneous	381.38
Total	3,956.97

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Very respectfully, your obedient servant,

LOUIS C. WOLF,
Additional Second Lieutenant, Corps of Engineers, U. S. A.

Col. CHAS. R. SUTER,
Corps of Engineers, U. S. A.

NATIONAL DEFENSE.

UNITED STATES ENGINEER OFFICE,
San Francisco, Cal., June 30, 1898.

COLONEL: I have the honor to submit the following report on the construction of one 8-inch emplacement on an island in San Francisco Bay, under the appropriation for "National Defense," act of March 9, 1898:

Work was commenced on April 1, 1898. For a considerable period all work was preparatory for the main work on the battery. It involved the building of stables, quarters, cook house, blacksmith shop, and office, the repair of wharf and road, and the cleaning of the quarry. By the 23d it had so far progressed that the main work could be commenced. On that day a considerable force commenced on the excavation; it was completed on May 13. In the excavation for the magazine building no difficulty at all was experienced. Rock was encountered near the front end of the magazine, but since it was solid it was allowed to form part of the wall of the magazine. The position of the gun platform was marked by a rough outcropping of rock, and here, owing to the difficulty of working the rock, which resulted partly from its hardness and partly from the fact that it consisted of a great number of bowlders surrounded by a softer material upon which a blast would have but little effect, the excavation proceeded only slowly and under heavy expense. On the 6th of May the foundation for magazine was put in; on the morning of the 16th the main concrete work commenced and was continued until the evening of the 20th, when, owing to lack of funds, work ceased. The concreting had reached 2 or 3 feet above the ceiling of the rooms. On the 27th work was resumed, an additional allotment having been made, and it was carried on until June 20, at which time the emplacement was completed. The cost of this emplacement was much increased by the great amount of preparatory work necessary, the long and heavy roads over which all material had to be brought, and the high prices of cement, lumber, and forage at the time. The work was pushed to completion as rapidly as possible considering the circumstances.

Statement of expenditures.

Quarters, buildings, etc	$3,417.73
Repair of wharf	158.00
Repair of roads	142.00
Quarry plant and cleaning quarry	1,587.21
Excavation	2,952.75
Forms, labor and material	1,491.45
Quarrying rock, $2,694.20; concrete work, material and labor, $9,371.17 (2,300 cubic yards of concrete at $5.25)	12,065.37
Steel bolts and I-beams	412.48
Plastering and pointing	82.00
Top finish, floors and sidewalks	335.00
Back fill	1,520.85
Water supply for camp	376.54
Water supply for battery	444.75
Moving machinery, pumping water, etc	145.00
Hauling and shipping material to site	498.93
Stables	3,110.45
Speaking tubes	68.55
Doors	443.09
Drains and sewers	96.95
Survey	180.92
Town office	224.01
Field office	545.00
Steamer *Yosemite*	161.50
Holidays	237.25
Tools, materials, etc., for buildings	356.76
Material and tools in quarry plant	365.19
Material and tools for emplacement	225.95
Smithy	357.70
Supplies and implements for stables	70.96
Watchman	119.00
Sundries	181.66
Trolleys	125.00
Total	32,500.00

Very respectfully, your obedient servant,

LOUIS C. WOLF,
Additional Second Lieutenant, Corps of Engineers, U. S. A.

Col. CHARLES R. SUTER,
Corps of Engineers, U. S. A.

TORPEDO DEFENSE OF SAN FRANCISCO.

Torpedo casemates.—An estimate of the cost of repairs to the torpedo casemate on an island in the bay was submitted November 27, 1895, amounting to $1,100, and but $900 was allowed by Department letter of July 8, 1896. This estimate was based on the condition of affairs at the time of the estimate, and on July 2, 1896, an inspection showed great change. The shore had been very much eroded, and it will now cost a far greater sum than the original estimate. It is proposed to wait for the present to see if this erosion continues, or is the result of a southeast storm of very unusual intensity, in which latter case the shore may build up again.

Money statement.

July 1, 1897, balance unexpended	$900.00
June 30, 1898, balance unexpended and available	900.00

A project was submitted May 11, 1897, for the construction of another torpedo casemate and gallery, to be located on the same island, and by Department indorsement of May 21, 1897, the sum of $8,000 was allotted for the work. In July, 1897, excavation for the casemate was commenced, and completed in August. The concrete work was then commenced, and completed in October, the casemate being finally finished and ready for occupancy in November, 1897. The work was done by hired labor.

Money statement.

July 1, 1897, balance unexpended	$8,000.00
June 30, 1898, amount expended during fiscal year	7,806.48
June 30, 1898, balance unexpended and available	193.52

TORPEDO STATION AT YERBA BUENA ISLAND.

Preservation and repair of fortifications.—During the year the keeper was employed in attending to the care and preservation of the torpedo material and other engineer property stored in the shed, in attending to the water supply, in the general policing of the station, and in rendering general assistance in the torpedo defense of the harbor, as well as at all times when work was going on at the station.

Money statement.

July 1, 1897, balance unexpended	$1,329.01
June 30, 1898, expended during fiscal year	721.12
June 30, 1898, balance unexpended and available	607.89

Cable tanks.—At the beginning of the fiscal year this work was only awaiting the arrival of the overhead traveler from the East. This was received early in the fiscal year, installed and tested, and the work finally completed in August, 1897. The cable tanks are now ready for the storage of torpedo cable.

Money statement.

June 30, 1897, balance unexpended	$2,310.57
June 30, 1898, expended during fiscal year	2,310.57

Torpedo shed.—During the fiscal year an overhead traveler, fitted with a Yale-Weston triplex block, for handling torpedo anchors, was installed, and the doors, which had never worked properly, were taken down and remodeled. With the exception of some racks, still to be built, the shed is completed.

Money statement.

June 30, 1897, balance unexpended	$1,210.29
June 30, 1898, expended during fiscal year	513.01
June 30, 1898, balance unexpended	697.28

Construction of a wharf, a keeper's dwelling, and for a water supply.—Nothing was done on this work during the fiscal year.

Money statement.

June 30, 1897, balance unexpended and available	$4,616.68
June 30, 1898, balance unexpended and available	4,616.68

NATIONAL DEFENSE.

An allotment of $2,000 was made for this work on March 18, 1898, from the appropriation for "National Defense," act of March 9, 1898; a further allotment of $15,000 on April 4, 1898, and on April 24, 1898, an additional $30,000 was allotted from the same appropriation, making a total available of $47,000.

As soon as instructions were received, in March, 1898, to commence on the torpedo defense of San Francisco Bay, arrangements were made to purchase such dynamite as might be required, at 15.8 cents per pound; and as there was no cable whatever at the torpedo station here for the work, all the submarine cable in the city was secured, and such insulated wire as could be obtained was purchased for the purpose of having it made into cable. Switch boxes for triple-junction boxes were loaded with cut-offs, and every preparation made that the available material permitted.

As the casemates which it was proposed to use in the emergency line of mines to be laid were not large enough for the engines, rotary transformers, and storage batteries, a shed, covered with corrugated iron, was erected alongside each casemate, and a trough was built, in which about 70 covered wires, each about 1,500 feet long, were laid to a small shed on the edge of the water, in which the submarine cables were gathered. By this method much submarine cable was saved.

Up to the end of the fiscal year 18½ miles of multiple cable and 32 miles of single cable were received from the Engineer Depot, about 1½ miles of single and 2½ miles of multiple cable purchased and armored here, and sufficient covered wire to make the connections between the casemate and the shed on the edge of the water was also purchased here. Thirty thousand pounds of dynamite were also purchased. Circuit closers, regulators, telephone apparatus, rotary transformers, switch boards, disconnectors, and multiple-cable boxes have also been received from the Engineer Depot.

The first mine was planted on June 11, 1898, and up to the end of the fiscal year 42 mines had been placed in position, grand-junction boxes had been located, and cable laid for two more grand groups.

The force at work consists of 1 commissioned officer, 6 enlisted men, and about 20 civilians, comprising boatmen, riggers, and laborers. We have a fine tugboat, derrick, scow, scow-schooner, and different kinds of boats for the service; but, although work is commenced at daybreak every morning in order to avoid the violent trade winds which blow strongly every day after about 11 or 12 o'clock, the continued rough seas and strong and uneven currents have rendered the progress very slow and less satisfactory than was hoped for.

Lieut. Francis R. Shunk, Corps of Engineers, has been and still is in local charge of the work. Lieut. M. L. Walker, Corps of Engineers, was also engaged on the work until May 24, 1898, when he was relieved by telegraphic orders.

Money statement.

March 18, 1898, amount allotted	$2,000.00
April 4, 1898, amount allotted	15,000.00
April 24, 1898, amount allotted	30,000.00
	47,000.00
June 30, 1898, amount expended to end of fiscal year	29,660.72
June 30, 1898, balance unexpended at end of fiscal year	17,339.28
June 30, 1898, outstanding liabilities at end of fiscal year	500.00
June 30, 1898, balance available at end of fiscal year	16,839.28

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4 V.

DEFENSES OF MOUTH OF COLUMBIA RIVER, OREGON AND WASHINGTON.

Officer in charge, Maj. Walter L. Fisk, Corps of Engineers; assistants, Maj. Clement A. F. Flagler, U. S. Volunteers, Captain, Corps of Engineers, to December 11, 1897, and Lieut. William D. Connor, Corps of Engineers, from September 30, 1897, to April 11, 1898; Division Engineer, Col. Charles R. Suter, Corps of Engineers.

On June 30, 1897, the work then under construction was the 10-inch-gun battery, electric-light station, and a mining casemate at one site, and the 8-inch gun battery, and a mining casemate at another location.

At the beginning of the present fiscal year the condition of the works was as follows:

Four emplacements for 10-inch rifles, disappearing carriages.—These emplacements were practically completed, with the disappearing carriages, L. F., model 1894, mounted in emplacements Nos. 2, 3, and 4, the guns received and on their way to the battery to be mounted. The battery fill was very nearly finished and the parados fill had been carried to elevation 40 feet, its completed height being at reference 54.8 feet. For the electric-light station, built in the parados, the concrete work was done, except the floors of the rooms.

Mining casemate (first site).—The concreting had been finished, including the covered gallery.

Two emplacements for 8-inch rifles, disappearing carriages.—The necessary quarters, shops, and other buildings, railroad tracks and trestles, etc., had been erected, and the receiving wharf completed. The concrete plant was practically finished, with the concrete materials on the ground. The excavation of the site for the emplacements had been made.

Mining casemate (second site).—Plans and estimates for its construction had been approved, but no work had been done upon it.

OPERATIONS DURING THE FISCAL YEAR.

Ten-inch gun battery, four emplacements.—The three 10-inch guns were mounted in emplacements 2, 3, and 4, in July. The disappearing carriage (L. F., model 1896) for emplacement No. 1 was received early in February and then mounted, and the gun for it unloaded from barge March 3 and mounted on March 20. The guns and carriages in emplacements 2, 3, and 4 were painted and the traverse rings oriented and marked. Rear stairways were built for the emplacements and hand rails put around the loading platforms.

The parapet, parados, and rear fills were completed and sodded. The total amount of sand deposited for these fills was 107,530 cubic yards, car measurement. A concrete parapet apron was put in for each gun. The total amount of concrete placed for the four emplacements was 13,208 cubic yards; 1,105 cubic yards of this was large rock in pieces.

A 12-inch sewer-pipe line, 1,020 feet long, with manhole and silt basin, was laid from the battery to the Swash Lake, surface drains and road gutter put in, all water connections made, and the ground in rear of the emplacements surfaced and covered with cinders.

This battery, as well as other work under construction and projected, is to be electrically lighted, and all wire connections and lamps for these emplacements are up and in working order. A storage battery of 52 cells is also provided for and installed, ready for charging.

These four emplacements are now entirely completed, excepting the steel cover for the observation station, with ammunition carriers, cranes, etc., and were turned over to the commanding officer, Fort Canby, March 16, when an officer of the artillery, with a small detachment, took charge of the battery.

The electric-light station was completed, 683 cubic yards of concrete having been used in its construction. It has a central boiler room 16 feet by 28 feet, and two engine and dynamo rooms, each 11 feet by 28 feet. Provision has been made to light the emplacements and to run the crane motors of all defense works and two search lights at this place from this one main station. The plant installed for this purpose consists of one Westinghouse 56¼ kilowatts, 125-volt multipolar compound wound dynamo, with switchboard and fittings, and an "Ideal" 65-horse power engine, for which steam is furnished from an 80-horsepower locomotive boiler. This plant was given a very satisfactory 24-hour continuous test under full load before acceptance. All wire connections have been made with the 10-inch battery and the mortar battery, and the dynamo and switch board are arranged to be operated in connection with the storage batteries.

At the close of the year preparations were being made for the construction of two additional emplacements for 10-inch guns, disappearing carriages, A. R. F., model 1896, plans and estimates for which were called for in letter from Chief of Engineers, dated June 4, 1898.

Mining casemate (first site).—This was completed, including 750 feet of gallery. Seven hundred and eighteen cubic yards of concrete and 12,263 cubic yards of sand, car measurement, for protection were used for its construction. In the casemate all shelves, tables, well covers, etc., were put in.

Surface drains were laid around the casemate fill, emptying into the moat of the old fort.

Emplacements for eight 12-inch mortars.—Work on this battery was commenced in August, clearing and grubbing the site. A surface railroad track, 1,950 feet long, had to be laid to connect with the existing system of tracks, and for the concreting and the dumping of sand for the parapet fill a switch-back trestle, 2,000 feet long and rising 32 feet above the level of the ground, was constructed, connecting with the old parados tracks, and then to the steam-shovel pit. To obtain sand for the mortar battery fill, the tracks in the sand pit were extended 1,200 feet.

Concreting was commenced on October 8, and, excepting the mortar and loading platforms and floors, completed January 20, during which time 5,957 cubic yards of concrete was placed; 216 cubic yards have

since been laid for floors in pit No. 1, and with the remaining 110 cubic yards to be placed in pit No. 2 the total number of yards of concrete for this battery will be 6,283.

The dumping of sand for the parapet fill began January 21 and ended in April, 39,740 cubic yards of sand, car measurement, having been deposited. The fill was sodded.

A 12-inch sewer-pipe line, 1,280 feet long, was laid from the mortar battery to the Swash Lake, having on its line the necessary manholes and silt basins.

The 10-inch battery and the mortar battery sewers empty into the Swash Lake, which itself is the receptacle for the drainage water from the low lands on and about the reservation. During the rainy season this Swash Lake at times rose to elevation nearly 12 feet, the level of the floors of the 10-inch battery. To guard against inundation and to effectually control the surface of the lake at a desired level, a wooden box drain, 3 feet by 10 feet in cross section, was constructed during September and October, and during the wet and stormy season was found to work satisfactorily.

The foundation of the mortar battery was tile drained and surface drains put down in the rear of the battery, together with all water connections from a 2-inch main connecting with the post water supply.

The first mortar carriage, No. 119, model 1896, was received March 13. Six additional carriages, also of model 1896, have arrived since this date, the last June 13, and all of them have been mounted. Pit No. 1 has its four carriages in place and is completed, the mortar and loading platforms concreted, and granolithic top finish. The concreting of pit No. 2 can not advantageously be done until the last carriage has been received and mounted. No mortars have yet been received. The wiring for the electric lighting of the battery has been done and the storage battery of 52 cells, with switch board, installed, ready for charging.

The mortar battery is essentially completed. The principal work remaining to be done is the mounting of the last carriage, and the concreting and finishing of the mortar and loading platforms in pit No. 2, removal of railroad trestle in rear of battery, and the cleaning up about and the finishing of the grounds.

Cable tank.—On April 4, 1898, the sum of $2,000 was allotted from the appropriation for "Torpedoes for Harbor Defense" for the construction of a cable tank and railroad for the wet storage of submarine cables. The work of construction began in April and was completed in May.

To connect this cable tank with the existing system of tracks a surface track 900 feet long had to be constructed. This track will also be used for a second tank, and a torpedo storehouse remaining to be built. A house was built over this tank, which is also provided with an overhead traveler, having a span of 18 feet 6 inches and a capacity of 4 tons, for convenience in handling the reels.

Preparations are being made for the construction of a second cable tank, authorized by telegram from the Chief of Engineers, dated June 29, 1898.

By the direction of the Chief of Engineers, two 10-inch S. B. guns, Nos. 18 and 19, in the left face of the old fort, were dismounted in November for the building of a 15-inch front-pintle platform on the site occupied by them. The new platform was built in December, and upon the arrival of the new carriage from San Francisco, May 11, it was mounted, and the 15-inch S. B. gun moved from the old center-pintle platform and mounted in the new carriage.

The construction of the platform for 15-inch smooth-bores was provided for by allotment of June 14, 1897, from appropriation for "Preservation and Repair of Fortifications."

Repairs: The old jetty shore and wharf trestle tracks, built in 1885 and 1886, were in such bad condition that it was unsafe longer to run trains over them, and repairs to them could no longer be postponed. The cheapest way to accomplish the repairs was to fill in the trestles with sand, using the steam shovel for loading the dump cars. Ten thousand seven hundred and sixty-seven cubic yards of sand was dumped for that purpose.

The foundation of the water-supply tank had to be renewed, a new windmill tower built, and a new driven well put down, using a 2-inch pipe driven 80 feet.

Two emplacements for 8-inch rifles, disappearing carriages.—Concreting for these began July 7, and, except finishing of floors, stairways, and platforms, was completed September 11. The excavation in the rear of the emplacements was not finished until near the end of the fiscal year, the material to be moved being mostly rock.

The total amount of excavation, including the roadway between emplacements 2 and 3 was 15,860 cubic yards, of which 12,475 cubic yards was earth and 3,385 cubic yards rock excavation, 4,300 cubic yards of the 12,475 was excavated some distance in front of the emplacements to secure the desired field of fire for the gun in emplacement No. 2. Of the amount of material excavated for the emplacements 9,900 cubic yards was deposited as fill in the parapet. The amount of concrete placed was 4,500 cubic yards. About 17 per cent of rock in large pieces from the rock excavation was incorporated in the concrete construction. The parapet and rear excavation slopes were sodded, and the roadway graded and finished off with a layer of rotten rock.

All sewers, surface drains, water connections, and the concrete road gutter are in, loading platform, handrails, and iron stairways up, and all ironwork and doors painted.

Three 8-inch B. L. rifles and one 8-inch disappearing carriage, L. F., model 1896, were received January 24. The carriage with its gun was mounted March 25. A second 8-inch carriage, L. F., model 1896, arrived April 22, and, together with the gun, was mounted on April 25.

After the parapet fill had taken its full settlement concrete aprons were put in for the two guns.

This battery is now entirely finished, complete with ammunition lifts, cranes, carriers, etc., except the steel cover of the observation station and the wiring and lamps for the electric lighting.

Emplacements for one 8-inch rifle, experimental disappearing carriage, model 1894.—In August excavation of the site of the emplacement was commenced, but not completed until December, owing to the large amount of rock to be removed. The rock excavation was 1,705 cubic yards and that of earth 3,910 cubic yards, 1,755 cubic yards of which was used in the parapet fill. Concreting began January 3 and was completed, with the exception of floors, stairs, and platforms, February 17. The total amount of concrete used in the construction of this emplacement was 2,805 cubic yards, and about 17 per cent of this was rock in pieces from the rock excavation.

The parapet fill was completed and sodded and the concrete apron put in and the ground surfaced.

The sewer, drains, water connections, railings, and stairs are in and all painting done.

This emplacement was fully completed in May, excepting the obser-

vation station steel cover, and the wiring and lamps for the lighting of the rooms and passages.

The experimental carriage, model 1894, has not yet been received.

For the electric lighting of all fortification works at Chinook Point an electric-light station is being constructed. It has two rooms—the boiler room, 16 feet by 32 feet, and the engine and dynamo room, 11 feet by 32 feet. One thousand nine hundred and eighty-five cubic yards of earth and 380 of rock were excavated for the site of this structure. Concreting began June 17 and was completed by the end of the month, excepting the floors, smokestack, and the plastering. Four hundred cubic yards of concrete was placed for the building. The back fill still remains to be done. The electric-light plant has not yet been purchased nor the wiring strung.

Mining casemate (second site).—Work upon this commenced in September. The casemate is entirely sunk into the ground and the excavation necessary to be made before the concrete foundation could be put in was 4,177 cubic yards of stiff clay. Six hundred and thirty-five cubic yards of concrete was laid for the casemate, which includes a gallery 400 feet long, all of which was completed early in March. The amount of earth back fill after the completion of the concreting was 3,540 cubic yards.

Repairs: In the wharf built last year the piling at the head of the wharf were being undermined by the strong tidal currents. In order to protect the wharf and make secure, 22 new piles were driven. No trouble has since occurred. At the shore end of the wharf about 200 cubic yards of large pieces of rock from the emplacement excavation was dumped around the piling of the Howe truss abutment.

Miscellaneous: The tug *G. H. Mendell* had the stern of the hull partly rebuilt, and the rock and sand barges, dump and flat cars, and locomotives were given the necessary running repairs.

The fortification work has been done by the Government by hired labor, with material purchased under sealed proposals.

All guns and carriages were mounted by the Engineer Department.

Money statements.

GUN AND MORTAR BATTERIES.

July 1, 1897, balance unexpended	$77,403.41
July 9, 1897 amount allotted	37,400.00
August 4, 1897, amount allotted	20,000.00
August 14, 1897, amount allotted	71,000.00
	205,803.41
June 30, 1898, amount expended during the fiscal year	180,857.39
July 1, 1898, balance unexpended	24,946.02
July 1, 1898, outstanding liabilities	7,897.21
July 1, 1898, balance available	17,048.81

TORPEDOES FOR HARBOR DEFENSE.

Mining casemate and cable tank (at first site).

July 1, 1897, amount unexpended	$6,475.84	
April 4, 1898, allotted for cable tank	2,000.00	
		$8,475.84
June 30, 1898, amount expended during the fiscal year		7,488.57
July 1, 1898, balance unexpended		987.27
July 1, 1898, outstanding liabilities		84.32
July 1, 1898, balance available		902.95

Mining casemate (at second site).

July 1, 1897, balance unexpended	$6,000.00
June 30, 1897, expended during the fiscal year	4,585.24
July 1, 1898, balance unexpended	1,414.76

OPERATIONS UNDER THE APPROPRIATION FOR NATIONAL DEFENSE.

An allotment of $4,000 was made April 11, 1898, from the appropriation "National Defense," act of March 9, 1898, for submarine mines at the mouth of the Columbia River, and on the 17th of the same month an additional allotment of $4,000 was made for the same purpose, together with $1,000 for repair to gun platforms.

There were received during the months of April, May, and June several shipments of torpedo materials, including torpedoes, anchors, tools, and submarine cables; also instruments and switchboard, oil engine, rotary transformer, storage battery, etc., for one casemate.

To accommodate the oil engine, transformer, and storage battery an additional room was built into the casemate fill of solid timber construction, the overhead timbers covered with 8 inches of concrete to exclude leakage, with plastered walls and ceiling and concrete floor. The room is 10 feet by 18 feet, the concrete walls of the casemate serving as two sides of the room. The oil engine, transformer, and storage battery have been placed and are working perfectly.

All wiring and connections with the transformer, storage battery, switchboard, and instrument have been made and testing of all the parts that require it practically completed.

The cable gallery is being uncovered and preparations made for the trying of the cables, etc. A complete triangulation system has been prepared for the planting of the torpedoes and the tracking of vessels.

None of the money has been expended on platforms, for the reason that consultation with the artillery officer in command of defenses at mouth of Columbia River developed the fact that there were more guns ready for service there than there was any possibility of manning.

Money statements.

NATIONAL DEFENSE, ACT OF MARCH 9, 1898.

Submarine mines.

April 11, 1898, amount allotted	$4,000.00
April 18, 1898, amount allotted	4,000.00
	8,000.00
June 30, 1898, amount expended during the fiscal year	676.23
July 1, 1898, balance unexpended	7,323.77
July 1, 1898, outstanding liabilities	2,724.86
July 1, 1898, balance available	4,598.91

Repairs to gun platforms.

April 18, 1898, amount allotted	1,000.00
July 1, 1898, amount unexpended	1,000.00
July 1, 1898, balance available	1,000.00

PRESERVATION AND REPAIR OF FORTIFICATIONS.

South side of river.—On June 14, 1897, an allotment of $1,000 was made for the construction of one wooden platform for 15-inch Rodman S. B., and for such repairs to quarters, etc., as might seem expedient. Some repairs were made in October, and by the 1st of January the platform and all work under this allotment was completed.

On April 30, 1898, an allotment of $1,000 was made for repairs to buildings, and the money thus appropriated has been expended on engineer buildings on fortification work.

North side of river.—One hundred and fifty dollars was allotted April 11, 1898, for repairs to powder magazine at this work. At an expenditure of $125 the old tin roof was removed and a new tin roof put on.

Money statement.

June 14, 1897, amount allotted	$1,000.00
April 11, 1898, amount allotted	150.00
April 30, 1898, amount allotted	1,000.00
	2,150.00
June 30, 1898, amount expended during the fiscal year	955.20
July 1, 1898, balance unexpended	1,194.80
July 1, 1898, outstanding liabilities	1,169.80
July 1, 1898, balance available	25.00

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4 W.

DEFENSES OF PUGET SOUND, WASHINGTON.

Officer in charge, Capt. Harry Taylor, Corps of Engineers; assistant, Lieut. Meriwether L. Walker, Corps of Engineers, until May 4, 1898, and from May 14, 1898; Division Engineer, Col. Charles R. Suter, Corps of Engineers.

A battery of four 10-inch guns and two 12-inch guns on nondisappearing carriages at one site, and four emplacements for 10-inch guns on disappearing carriages and a battery for sixteen 12-inch mortars at another locality have been under construction by contract during the year.

At the beginning of the year plans for the 2-gun batteries had been prepared and approved, proposals for the 6-gun battery had been received, and advertisements issued for the construction of four 10-inch gun emplacements.

Battery for four 10-inch and two 12-inch guns.—The award of the contract for this battery to the Pacific Bridge Company was approved by the Chief of Engineers July 10, 1897, and an allotment of $175,000 was made July 12, 1897, to cover the payments under this contract and the expenses of inspection, etc.

Work under this contract was commenced July 31, 1897, when pile-driving in the wharf was begun. Clearing at the site of the battery was commenced August 9; excavating and grading was commenced September 10, 1897, and concreting February 10, 1898.

According to the terms of the contract, the entire work should be completed July 16, 1898. The time allowed by the specifications was ample

for the completion of the work had it been carried on in a moderately energetic manner from the beginning, but much valuable time was lost in the fall, which carried work which should have been done during the pleasant weather season over into the winter rainy season, causing still more time to be lost.

At the end of the fiscal year two of the 10-inch emplacements are completed so far as the heavy work is concerned, but they still lack the lifts, trolleys, and all other metal work, and the general finishing up. The other two 10-inch emplacements have the concrete about half laid and the forms for the balance of the concrete work in place. The two 12-inch emplacements have the excavation completed, the floors laid, and the forms for the concrete practically completed. The four 10-inch platforms are ready to receive the carriages. The 12-inch platforms will be put in in about three weeks. The entire contract should be completed on or before November 1, 1898.

The following are the various items and their estimated amounts included in the contract and the amounts placed, and accepted during the year:

Items.		Quantity.	Accepted and placed.
Clearing	acres	28	21
Excavation	cubic yards	178,400	94,781
Concrete:			
No. 1	do	500	108
No. 2	do	2,400	2,450
No. 3	do	15,900	3,734
Granolithic surfacing	square yards	4,500	485
Whitewashing	squares of 100 feet	400	.....
Broken stone for blind drains	cubic yards	150	44
Large rock	tons	750	.....
Steel beams, etc	pounds	154,000	76,226
Cast-iron drain pipe:			
8-inch	linear feet	1,150	1,129
6-inch	do	460	777
Tile drain pipe, 6-inch	do	1,500	1,888
Galvanized wrought-iron pipe:			
2½-inch	do	560	75
2-inch	do	400	220
1¼-inch	do	3,400	717
Cast-iron manholes, gratings, etc	pounds	3,500	1,780
Doors, steel, double leaf:			
6 feet by 8 feet	number	6	.....
4 feet by 8 feet	do	6	.....
Doors steel, single leaf:			
4 feet by 8 feet	do	24	.....
3 feet by 8 feet	do	20	.....
Cranes	do	12	.....
Lifts, double	pairs	12	.....
Trolley track	pounds	19,000	.....
Trolleys	number	24	.....
Steel anchor bolts	pounds	8,400	4,021
Cast-iron anchor plates	do	4,200	1,762
Miscellaneous	do	1,000	1,458
Asphalting	square yards	1,700	.....
Piling	linear feet	11,000	8,739
Lumber	feet B. M.	80,000	142,198
Iron	pounds	7,000	5,498

Money statement.

Amount allotted during fiscal year		$175,000.00
June 30, 1898, amount expended during fiscal year		54,145.29
July 1, 1898, balance unexpended		120,854.71
July 1, 1898, outstanding liabilities	$36.50	
July 1, 1898, amount covered by uncompleted contracts	119,938.15	
		119,974.65
July 1, 1898, balance available		880.06

Contract in force during fiscal year ending June 30, 1898.

Name of contractor: Pacific Bridge Company.
Date of contract: July 28, 1897.
Date of approval: September 2, 1897.
Time of commencement: July 27, 1897.
Time of completion: July 16, 1898.

Emplacements for four 10-inch guns.—Proposals for the construction of the four 10-inch emplacements were opened July 31, 1897, and the award of the contract to the lowest bidders, Maney, Goerig & Rydstrom, approved by the Chief of Engineers, August 13, 1897. Under date of August 31, 1897, an allotment of $95,000 was made to cover the payments under this contract, and the expenses of inspection, etc. Work was commenced August 31, 1897. Concreting was commenced March 5, 1898. According to the terms of the contract, the entire work should have been completed June 27, 1898.

At the end of the fiscal year two emplacements were practically completed except for the lifts, trolleys, and other metal work, and general finishing up. The other two emplacements were well along, the platforms having been laid, the floors laid, the forms nearly all up, and the walls of the various rooms partially finished. This contract would probably have been nearer completion had it not been for the rejection of the first cargo of cement received, necessitating a delay until another cargo came in. This contract should be completed before September 1, 1898.

The following are the various items and their estimated amounts included in the contract, and the amounts accepted and placed during the year:

Items.		Quantity.	Accepted and placed.
Clearing	acres	5	2.028
Excavation	cubic yards	40,000	37,154
Concrete:			
No. 1	do	500	22.27
No. 2	do	2,120	981.73
No. 3	do	10,000	8,240.73
Granolithic surfacing	square yards	1,800	.....
Whitewashing	squares of 100 feet	240	.....
Broken stone for blind drains	cubic yards	100	62
Large rock	tons	700	.....
Steel beams, etc	pounds	96,000	91,805
Cast-iron drainpipe:			
12-inch	linear feet	900	1,006.8
6-inch	do	750	843.6
Tile drainpipe, 6-inch	do	1,000	537
Galvanized wrought-iron pipe:			
2½-inch	do	400	397.33
2-inch	do	300	478
1½-inch	do	1,000	800
Cast-iron manholes, grating, etc	pounds	2,000	2,776
Doors, steel, double leaf:			
6 feet by 8 feet	number	4	.....
4 feet by 8 feet	do	4	.....
Doors, steel, single leaf:			
4 feet by 8 feet	do	12	.....
3 feet by 8 feet	do	9	.....
Cranes	do	8	.....
Lifts, double	pairs	8	.....
Trolley track	pounds	13,200	.....
Trolleys	number	16	.....
Steel anchor bolts	pounds	6,000	6,120
Cast-iron anchor plates	do	2,700	2,193
Miscellaneous iron	do	800	1,165
Asphalting	square yards	800	.....
Piling	linear feet	11,000	16,845
Lumber	feet, B. M.	80,000	139,340
Iron	pounds	7,000	6,512

Money statement.

Amount allotted during fiscal year		$95,000.00
June 30, 1898, amount expended during fiscal year		45,125.46
July 1, 1898, balance unexpended		49,874.54
July 1, 1898, outstanding liabilities	$80.00	
July 1, 1898, amount covered by uncompleted contracts	49,294.68	
		49,374.68
July 1, 1898, balance available		499.86

Abstract of proposals received by Capt. Harry Taylor, Corps of Engineers, United States Army, July 31, 1897, for constructing four gun emplacements.

Materials.	Quantity.	1. Maney, Goerig & Rydstrom, Everett, Wash.		2. W. L. Prather, Oakland, Cal.		3. Anton Giebisch, Portland, Oreg.	
		Bid.	Amount.	Bid.	Amount.	Bid.	Amount.
Clearing ....acres..	5	$75.00	$375.00	$20.00	$100.00	$100.00	$500.00
Excavation....cubic yards..	40,000	.22	8,800.00	.29	11,600.00	.25	10,000.00
Concrete:							
No. 1 ....do....	500	6.35	3,175.00	7.50	3,750.00	6.15	3,075.00
No. 2 ....do....	2,120	5.05	10,706.00	6.50	13,780.00	5.85	12,402.00
No. 3 ....do....	10,000	4.20	42,000.00	5.90	59,000.00	4.95	49,500.00
Granolithic surfacing, square yards....	1,800	.15	270.00	.50	900.00	.90	1,620.00
Whitewashing ....squares..	240	.40	96.00	.50	120.00	.25	60.00
Broken stone for blind drains, cubic yards....	100	2.00	200.00	2.00	200.00	1.50	150.00
Large rock....tons..	700	2.00	1,400.00	2.50	1,750.00	1.50	1,050.00
Steel beams, etc ....pounds..	96,000	.03¼	3,120.00	.03½	3,360.00	.05	4,806.00
Cast-iron drainpipe:							
12-inch....linear feet..	900	1.25	1,125.00	.90	810.00	1.50	1,350.00
6-inch....do....	750	.65	487.50	.60	450.00	.40	300.00
Tile drainpipe, 6-inch...do....	1,000	.14	140.00	.20	200.00	.30	300.00
Galvanized wrought-iron pipe:							
2½-inch....linear feet..	400	.20	80.00	.30	120.00	.36	144.00
2-inch....do....	300	.13	39.00	.20	60.00	.24	72.00
1½-inch....do....	1,000	.10	100.00	.15	150.00	.18	180.00
Cast-iron manholes, gratings, etc....pounds..	2,000	.04	80.00	.05	100.00	.04	80.00
Doors, steel, double leaf:							
6 feet by 8 feet	4	59.00	236.00	70.00	280.00	130.00	520.00
4 feet by 8 feet	4	55.00	220.00	60.00	240.00	89.00	356.00
Doors, steel, single leaf:							
4 feet by 8 feet	12	48.00	576.00	50.00	600.00	79.00	948.00
3 feet by 8 feet	9	45.00	405.00	50.00	450.00	55.00	495.00
Cranes	8	125.00	1,000.00	200.00	1,600.00	150.00	1,200.00
Lifts, double ....pairs..	8	500.00	4,000.00	900.00	7,200.00	500.00	4,000.00
Trolley track ....pounds..	13,200	.08	1,056.00	.15	1,980.00	.10	1,320.00
Trolleys....	16	60.00	960.00	90.00	1,440.00	40.00	640.00
Steel anchor bolts....pounds..	6,000	.06½	390.00	.07	420.00	.06	360.00
Cast-iron anchor plates .do....	2,700	.04	108.00	.05	135.00	.04	108.00
Miscellaneous iron....do....	800	.07	56.00	.05	40.00	.05	40.00
Asphalting....square yards..	800	1.50	1,200.00	3.50	2,800.00	1.50	1,200.00
Piling:							
Summer cut ..linear feet..	11,000	.09	.....	.20	.....	.13	.....
Winter cut ....do....	11,000	.10	1,100.00	.30	3,300.00	.18	1,980.00
Lumber ....feet, B. M..	80,000	15.00	1,200.00	20.00	1,600.00	16.00	1,280.00
Iron ....pounds..	7,000	.04	280.00	.05	350.00	.04	280.00
Total....	.....	.....	84,980.50	.....	118,885.00	.....	100,310.00

Abstract of proposals received by Capt. Harry Taylor, Corps of Engineers, United States Army, July 31, 1897, for constructing four gun emplacements—Continued.

Materials.	Quantity.	4. Hale & Kern, Contract Co., Portland, Oreg.		5. Chas. E. Cotton, Oakland, Cal., Wm. H. Healy, San Francisco, Cal.		6. Walter D. Pugh and Charles A. Gray, Salem, Oreg.	
		Bid.	Amount.	Bid.	Amount.	Bid.	Amount.
Clearing ..... acres..	5	$75.00	$375.00	$60.00	$300.00	$110.00	$550.00
Excavation ..... cubic yards..	40,000	.23	9,200.00	.20	8,000.00	.28½	11,400.00
Concrete:							
No. 1 ..... do....	500	8.25	4,125.00	6.90	3,450.00	6.58	3,290.00
No. 2 ..... do....	2,120	6.55	13,886.00	5.95	12,614.00	5.30	11,236.00
No. 3 ..... do....	10,000	5.75	57,500.00	4.90	49,000.00	4.54	45,400.00
Granolithic surfacing, square yards	1,800	.20	360.00	.80	1,440.00	.65	1,170.00
Whitewashing ..... squares..	240	.20	48.00	.25	60.00	.44	105.60
Broken stone for blind drains, cubic yards	100	1.50	150.00	2.00	200.00	1.65	165.00
Large rock ..... tons..	700	1.75	1,225.00	1.25	875.00	2.74	1,918.00
Steel beams, etc ..... pounds..	96,000	.02 3/10	2,688.00	.03¼	3,120.00	.03¾	3,360.00
Cast-iron drainpipe:							
12-inch ..... linear feet..	900	1.55	1,395.00	.99	891.00	.99	891.00
6-inch ..... do....	750	.30	225.00	.75	562.50	.45	337.50
Tile drainpipe, 6-inch ... do....	1,000	.10	100.00	.15	150.00	.12	120.00
Galvanized wrought-iron pipe:							
2½-inch ..... linear feet..	400	.24	96.00	.25	100.00	.26	104.00
2-inch ..... do....	300	.18	54.00	.20	60.00	.19	57.00
1½-inch ..... do....	1,000	.14	140.00	.15	150.00	.14	140.00
Cast-iron manholes, gratings, etc ..... pounds..	2,000	.04	80.00	.05	100.00	.04½	90.00
Doors, steel, double leaf:							
6 feet by 8 feet	4	55.00	220.00	75.00	300.00	59.00	236.00
4 feet by 8 feet	4	50.00	200.00	65.00	260.00	53.00	212.00
Doors, steel, single leaf:							
4 feet by 8 feet	12	50.00	600.00	50.00	600.00	49.00	588.00
3 feet by 8 feet	9	46.00	414.00	40.00	360.00	43.00	387.00
Cranes	8	110.00	880.00	125.00	1,000.00	165.00	1,320.00
Lifts, double ..... pairs..	8	500.00	4,600.00	650.00	5,200.00	650.00	5,200.00
Trolley track ..... pounds..	13,200	.05	660.00	.08	1,056.00	.06	792.00
Trolleys	16	30.00	480.00	70.00	1,120.00	60.00	960.00
Steel anchor bolts .... pounds..	6,000	.04	240.00	.08	480.00	.06	360.00
Cast-iron anchor plates .do....	2,700	.04	108.00	.05	135.00	.04	108.00
Miscellaneous iron ..... do....	800	.04	32.00	.08	64.00	.06	48.00
Asphalting .... square yards..	800	2.30	1,840.00	125.00	1,000.00	2.00	1,600.00
Piling:							
Summer cut .. linear feet..	11,000	.11	.....	.11	.....	.15	.....
Winter cut ..... do....	11,000	.11	1,210.00	.12	1,320.00	.16	1,760.00
Lumber ..... feet, B. M..	80,000	11.00	880.00	13.00	1,040.00	14.00	1,120.00
Iron ..... pounds..	7,000	.03	210.00	.03	210.00	.04½	315.00
Total	.....	.....	103,621.00	.....	95,217.50	.....	95,340.10

Abstract of proposals received by Capt. Harry Taylor, Corps of Engineers, United States Army, July 31, 1897, for constructing four gun emplacements—Continued.

Materials.	Quantity.	7. Pacific Bridge Co., Portland, Oreg.		8. Hugh Foy, San Francisco, Cal.		9. Nichols & Crothers, Tacoma, Wash.	
		Bid.	Amount.	Bid.	Amount.	Bid.	Amount.
Clearing ..... acres..	5	$100.00	$500.00	$150.00	$750.00	$60.00	$300.00
Excavation ..... cubic yards..	40,000	.29	11,600.00	.30	2,000.00	.28	11,200.00
Concrete:							
No. 1 ..... do....	500	5.95	2,975.00	7.25	3,625.00	7.50	3,750.00
No. 2 ..... do....	2,120	4.84	10,260.80	6.00	12,720.00	5.40	11,448.00
No. 3 ..... do....	10,000	4.32	43,200.00	5.25	52,500,00	4.15	41,500.00
Granolithic surfacing, square yards	1,800	.40	720.00	.30	540.00	.40	720.00
Whitewashing ..... squares..	240	.25	60.00	.20	48.00	.40	96.00
Broken stone for blind drains, cubic yards	100	1.25	125.00	.03	300.00	1.25	125.00
Large rock ..... tons..	700	2.15	1,505.00	3.50	2,450.00	150.00	1,050.00
Steel beams, etc ..... pounds..	96,000	.03	2,880.00	.02½	2,400.00	.03½	3,360.00
Cast-iron drainpipe:							
12-inch ..... linear feet..	900	1.25	1,125.00	1.50	1,350.00	1.15	1,035.00
6-inch ..... do....	750	.40	300.00	.50	375.00	.60	450.00
Tile drainpipe, 6-inch ... do....	1,000	.12	120.00	.10	100.00	.20	200.00
Galvanized wrought-iron pipe:							
2½-inch ..... linear feet..	400	.25	100.00	.20	80.00	.25	100.00
2-inch ..... do....	300	.20	60.00	.15	45.00	.20	60.00
1¼-inch ..... do....	1,000	.15	150.00	.10	100.00	.18	180.00
Cast-iron manholes, gratings, etc ..... pounds..	2,000	.04	80.00	.03	60.00	.04	80.00
Doors, steel, double leaf:							
6 feet by 8 feet	4	65.00	260.00	50.00	200.00	45.00	180.00
4 feet by 8 feet	4	45.00	180.00	45.00	180.00	40.00	160.00
Doors, steel, single leaf:							
4 feet by 8 feet	12	42.00	504.00	40.00	480.00	35.00	420.00
3 feet by 8 feet	9	35.00	315.00	35.00	315.00	30.00	270.00
Cranes	8	125 00	1,000.00	120.00	960.00	145.00	1,160.00
Lifts, double ..... pairs..	8	790.00	6,320.00	500.00	4,000.00	525.00	4,200.00
Trolley track ..... pounds..	13,200	.10	1,320.00	.07	924.00	.06	792.00
Trolleys	16	70.00	1,120.00	60.00	960.00	50.00	800.00
Steel anchor bolts .... pounds..	6,000	.06	360.00	.06	360.00	.06	360.00
Cast-iron anchor plates .. do....	2,700	.04	108.00	.03	81.00	.04	108.00
Miscellaneous iron ..... do....	800	.05	40.00	.12	96.00	.12	96.00
Asphalting .... square yards..	800	1.90	1,520.00	1.50	1,200.00	1.40	1,120.00
Piling:							
Summer cut .. linear feet..	11,000	.13	.....	.16	.....	.09½	.....
Winter cut ..... do....	11,000	.15	1,650.00	.16	1,760.00	.10½	1,155.00
Lumber ..... feet, B. M..	80,000	13.00	1,040.00	20.00	1,600.00	12.00	960.00
Iron ..... pounds..	7,000	.04	280.00	.05	350.00	.05	350.00
Total	.....	.....	91,777.80	.....	102,909.00	.....	87,785.00

Contract in force during fiscal year ending June 30, 1898.

Name of contractors: Maney, Goerig & Rydstrom.
Date of contract: August 24, 1897.
Date of approval: November 20, 1897.
Time of commencement: August 28, 1897.
Time of completion: June 27, 1898.
Time of completion extended to August 15, 1898.

Mortar battery.—Plans and specifications for a mortar battery mounting sixteen 12-inch mortars were prepared and forwarded to the Chief of Engineers, November 16, 1897. These having been duly approved, advertisements were issued and proposals for the construction of the battery were received and opened January 26, 1898. A contract for the construction of this battery was made with Messrs. Maney, Goerig & Rydstrom, the lowest bidders, who are also the contractors for the gun emplacements at the same point. The time allowed for the completion of this contract is until February 11, 1899.

At the end of the fiscal year the site of the battery had been cleared, the excavation for one of the pits had been practically completed, and that for another of the pits started, and preparations for laying con-

crete were well along. There is no apparent reason why this contract should not be completed within the time allowed by the specifications.

The work done under this contract to the end of the year is as follows:

Clearing	acres	4.6
Excavation	cubic yards	6,291

Money statement.

Amount allotted during fiscal year		$90,000.00
June 30, 1898, amount expended during fiscal year		2,575.21
July 1, 1898, balance unexpended		87,424.79
July 1, 1898, outstanding liabilities	$130.00	
July 1, 1898, amount covered by uncompleted contracts	79,301.83	
		79,431.83
July 1, 1898, balance available		7,992.96

Abstract of proposals received by Capt. Harry Taylor, Corps of Engineers, United States Army, in response to advertisement dated December 22, 1897, for constructing a mortar battery for sixteen mortars.

Materials.	Quantity.	1. Pacific Bridge Co., San Francisco, Cal.		2. Maney, Goerig & Rydstrom, Port Townsend, Wash.		3. W. L. Prather, jr., Oakland, Cal.	
		Bid.	Amount.	Bid.	Amount.	Bid.	Amount.
Clearing ... acres	6	$200.00	$1,200.00	$125.00	$750.00	$100.00	$600.00
Excavation ... cubic yards	35,000	.39	13,650.00	.35	12,250.00	.30	10,500.00
Concrete:							
No. 1 ... do	582	8.00	4,656.00	7.25	4,219.50	6.70	3,899.40
No. 2 ... do	4,946	6.85	33,880.10	5.75	28,439.50	5.90	29,181.40
No. 3 ... do	2,662	5.75	15,306.50	4.50	11,979.00	5.40	14,374.80
Granolithic surfacing ... sq. yds	1,440	.65	936.00	.30	432.00	.90	1,296.00
Whitewashing ... sq. of 100 ft	299	.25	74.75	.40	119.60	.30	89.70
Broken stone for blind drains, cubic yards	100	1.85	185.00	2.00	200.00	2.90	290.00
Steel beams, etc ... pounds	185,540	.03 3/10	7,050.52	.03¾	6,957.75	.04½	8,349.30
Vitrified sewer pipe:							
8-inch ... linear feet	700	.75	525.00	.65	455.00	.35	245.00
6-inch ... do	1,400	.55	770.00	.40	560.00	.30	420.00
Tile drain pipe:							
6-inch ... do	1,500	.18	270.00	.14	210.00	.20	300.00
4-inch ... do	100	.12	12.00	.09	9.00	.20	20.00
Hollow brick facing ... sq. yds	2,000	1.00	2,000.00	.75	1,500.00	.99	1,980.00
Galvanized wrought-iron pipe:							
2-inch ... linear feet	600	.28	168.00	.15	90.00	.30	180.00
1½-inch ... do	300	.23	69.00	.12	36.00	.25	75.00
Cast-iron manholes, gratings, etc ... pounds	2,000	.05	100.00	.04	80.00	.04	80.00
Doors, steel, double leaf:							
10 feet by 7 feet ... number	8	128.00	1,024.00	115.00	920.00	150.00	1,200.00
4 feet by 7 feet ... do	9	85.00	765.00	55.00	495.00	100.00	900.00
Doors, steel, single leaf:							
3 feet by 7 feet ... do	14	55.00	770.00	40.00	560.00	60.00	840.00
2½ feet by 7 feet ... do	5	45.00	225.00	35.00	175.00	50.00	250.00
Trolley track ... pounds	19,000	.10½	1,995.00	.08	1,520.00	.08	1,520.00
Trolleys, 1-ton ... number	24	85.00	2,040.00	75.00	1,800.00	50.00	1,200.00
Steel anchor bolts and nuts, pounds	23,776	.06	1,426.56	.06	1,426.56	.04	951.04
Cast-iron anchor plates ... lbs	16,600	.04½	747.00	.04	664.00	.04	664.00
Miscellaneous iron ... do	500	.08	40.00	.07	35.00	.04	20.00
Asphalting ... square yards	1,254	1.85	2,319.90	1.65	2,069.10	.50	627.00
Woodwork for electric wiring, linear feet	1,000	.25	250.00	.10	100.00	.06	60.00
Total			92,455.37		78,052.01		80,112.64

Contract in force during fiscal year ending June 30, 1898.

Name of contractors: Maney, Goerig & Rydstrom.
Date of contract: February 28, 1898.
Date of approval: April 23, 1898.
Time of commencement: April 12, 1898.
Time of completion: February 11, 1899.

The estimated amount of excavation for the gun emplacements proving to be too small, advertisements were issued for making the remainder of the necessary excavation. Proposals for this were received and opened June 30, 1898.

Abstract of proposals received by Capt. Harry Taylor, Corps of Engineers, United States Army, in response to advertisement dated May 31, 1898, for excavating and grading, opened June 30, 1898.

No.	Name.	Address.	Price per cubic yard.	Amount.
			Cents.	
1	J. A. Bailey	Seattle, Wash	48	$14,400
2	W. F. Nelson	Port Townsend, Wash	27	8,100
3	Simon Normile	Astoria, Oreg	23	6,900
4	Peter M. Coyne	Port Townsend, Wash	37½	11,250
5	Maney, Goerig & Rydstrom	do	36¾	11,025

The totals are based on the estimated quantity of 30,000 cubic yards. No allotment has been made for the work. A written contract will be entered into. It is recommended that the bid of Simon Normile, of Astoria, Oreg., the lowest bidder, be accepted.

Battery for five 10-inch and two 12-inch guns.—Plans for a battery mounting five 10-inch and two 12-inch guns on barbette carriages at a third locality were prepared. The allotment for "Plans for Defenses at Puget Sound, Washington," was originally made for working up the plans for the defenses at the first two points before any allotment for the construction of these works was made. The plans for these defenses were practically finished before the end of the last fiscal year, and only a small amount of work, finishing up the details of the plans, has been chargeable to this allotment.

Money statements.

July 1, 1897, balance unexpended	$179.86
June 30, 1898, amount expended during fiscal year	111.09
July 1, 1898, balance unexpended	68.77
July 1, 1898, outstanding liabilities	2.75
July 1, 1898, balance available	66.02

Sites.—A third site at Puget Sound, in addition to the two mentioned in report for 1897, was obtained, partly by purchase and partly by condemnation. The condemnation proceedings were held March 24, 1898, and at the end of the year this transfer of title had been completed, except the recording in the proper county records of the decree of condemnation and other necessary papers. These were forwarded to the proper officer for record on the last day of the year.

Two sites for fortification purposes were selected on Richs Passage to Port Orchard during the year, and condemnation proceedings for acquiring title to these were begun.

Money statements.

SITES FOR FORTIFICATIONS AND SEACOAST DEFENSES.

For surveys and incidental expenses.

July 1, 1897, balance unexpended	$9.68
Allotted since	3.32
	13.00
June 30, 1898, amount expended during fiscal year	13.00

Site No. 1.

July 1, 1897, balance unexpended	$2,580.00
June 30, 1898, amount expended during fiscal year	2,580.00

Site No. 3.

July 1, 1897, amount available	$43,075.00
June 30, 1898, amount expended during fiscal year	3,027.45
July 1, 1898, balance unexpended	40,047.55
July 1, 1898, outstanding liabilities	32,050.00
July 1, 1898, balance available	7,997.55

Armament.—Two nondisappearing carriages for 12-inch guns, two nondisappearing carriages for 10-inch guns, and six mortar carriages were received during the year, but none were mounted, on account of the interference which would have been caused with the construction work in progress. As no guns were received, nothing would have been gained by mounting the carriages. Under date of March 28, 1898, an allotment of $7,000 was made for mounting carriages and guns. Some plant was purchased and plans made for doing the work at the proper time.

Money statement.

Amount allotted during fiscal year	$7,000.00
June 30, 1898, amount expended during fiscal year	920.82
July 1, 1898, balance unexpended	6,079.18
July 1, 1898, outstanding liabilities	2,350.00
July 1, 1898, balance available	3,729.18

A reconnaissance was made at Port Angeles, Wash., for the purpose of obtaining data for developing a plan of defense for that place. A report and map were forwarded December 24, 1897.

Money statement.

Amount allotted during fiscal year	$75.00
June 30, 1898, amount expended during fiscal year	75.00

RIVERS AND HARBORS, ETC.

APPENDIX A.

IMPROVEMENT OF RIVERS AND HARBORS IN MAINE AND NEW HAMPSHIRE.

REPORT OF MAJOR R. L. HOXIE, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1898, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Lubec Channel, Maine.
2. Moosabec Bar, Maine.
3. Narraguagus River, Maine.
4. Breakwater from Mount Desert to Porcupine Island, Bar Harbor, Maine.
5. Harbor at Sullivan Falls, Maine.
6. Union River, Maine.
7. Bagaduce River, Maine.
8. Penobscot River, Maine.
9. Rockland Harbor, Maine.
10. Carvers Harbor, Vinal Haven, Maine.
11. Georges River, Maine.
12. Kennebec River, Maine.
13. Sasanoa River, Maine.
14. Portland Harbor, Maine.
15. Saco River, Maine.
16. Cocheco River, New Hampshire.
17. Little Harbor, New Hampshire.
18. Removing sunken vessels or craft obstructing or endangering navigation.

SURVEYS.

19. Union River, Maine.
20. Bagaduce River, Maine.

UNITED STATES ENGINEER OFFICE,
Portland, Me., July 25, 1898.

GENERAL: I have the honor to forward annual report for the fiscal year 1898 for river and harbor works in my charge.

Very respectfully, your obedient servant,

R. L. HOXIE,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

A 1.

IMPROVEMENT OF LUBEC CHANNEL, MAINE.

The approved project and the report of progress of the work up to June 30, 1897, will be found in the Report of the Chief of Engineers for 1898, Part I, page 36.

The expenditures during the fiscal year 1898 were $31,068.06. The operations consisted in dredging, under a contract with Moore & Wright

for widening the channel. The total quantity of material removed under this contract was 56,000 cubic yards, the contract being completed October 1, 1897, since which time no work has been done. The channel has been widened under the present project about 170 feet at the entrance and about 190 feet at the turn just above Cranberry Point. The most difficult and expensive part of the work (that in the Narrows) was completed.

The improvements render less difficult the passage of a way which is subject to strong currents and frequent fogs.

There is a light-house about 1 mile to the southward of Lubec on the westerly side of the dredged channel. Lubec Narrows is in the collection district of Passamaquoddy.

Money statement.

July 1, 1897, balance unexpended	$32,178.56
June 30, 1898, amount expended during fiscal year	31,068.06
July 1, 1898, balance unexpended	1,110.50
July 1, 1898, outstanding liabilities	10.00
July 1, 1898, balance available	1,100.50
Amount (estimated) required for completion of existing project	78,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	78,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

APPROPRIATIONS.

March 3, 1879	$44,000
June 14, 1880	20,000
March 3, 1881	45,000
August 2, 1882	20,000
July 5, 1884	10,000
August 5, 1886	10,000
August 11, 1888	20,000
August 18, 1894	5,000
August 18, 1894, unexpended balance for improving St. Croix River, made available for Lubec Channel	35,000
June 3, 1896	32,000
Total	241,000

Contract in force during the fiscal year ending June 30, 1898.

No.	Contractor.	Date.	Subject.	Price per cubic yard.	Date of approval.	Beginning of work.	Expiration.
1	Moore & Wright, Portland, Me.	May 4, 1897	Dredging channel, upper shoals.	$1.00	May 20, 1897	Aug. 1, 1897	July 1, 1898
			Dredging channel below.	.27			

Contract completed.

COMMERCIAL STATISTICS.

Receipts and shipments.

	Tons.
1896	52,300
1897:	
Bricks and lime	800
Coal and wood	5,500
Fish	27,500
General merchandise	1,500
Lumber and sardine stock	1,200
Lead and tin	7,700
Oil and mustard	4,000
Provisions and grain	3,200
Salt	2,000
Total	53,400

Arrivals and departures in calendar year 1897.

Steamers, average tonnage 1,500, draft 14 feet	392
Sailing vessels, average tonnage 100, draft 10 feet	96

Vessels built.

Steamers, tonnage 20	1
Sailing vessels, tonnage 13	1

The foregoing represents the commerce of the town of Lubec only. The keeper of Quoddy Head Light Station reports that 957 steamers and 7,054 sailing vessels of all classes passed through Lubec Channel in daylight during calendar year 1897.

A 2.

IMPROVEMENT OF MOOSABEC BAR, MAINE.

The approved project and the report of progress of the work up to June 30, 1897, will be found in the Report of the Chief of Engineers for 1898, Part I, page 37.

The expenditures during the fiscal year 1898 were $14,560.88. The operations consisted in the removal of ledge in the western approach to the channel under a contract with Townsend & Johnston, which was in progress at the close of the fiscal year 1897. This contract was completed in August, 1897, the total quantity of ledge taken out being 656.9 cubic yards. Work was at once commenced under a contract with William D. Johnston, which was completed in September, 1897, about 584 cubic yards of ledge being removed. Under these operations the removal of Ledge E was completed and a small amount of work was done on that part of Ledge G remaining to be removed. No work has been done since.

The improvement is in the collection district of Machias, Me., which is the nearest port of entry. The nearest light-house is Moose Peak.

Money statement.

July 1, 1897, balance unexpended	$15,030.93
June 30, 1898, amount expended during fiscal year	14,560.88
July 1, 1898, balance unexpended	470.05
Amount (estimated) required for completion of existing project	11,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	11,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

APPROPRIATIONS.

March 3, 1881	$10,000	July 13, 1892	$15,000
August 2, 1882	10,000	August 18, 1894	6,000
July 5, 1884	10,000	June 3, 1896	12,000
August 5, 1886	10,000		
August 11, 1888	15,000		103,000
September 19, 1890	15,000		

List of contracts in force during the fiscal year ending June 30, 1898.

No.	Contractors.	Date.	Subject.	Price per cubic yard.	Date of approval.	Beginning of work.	Expiration.
a 1	Townsend & Johnston, Somers Point, N. J.	Mar. 9, 1895	Removal of ledge.	$13.20	Mar. 19, 1895	May 1, 1895	Aug. 28, 1897
a 2	William D. Johnston, Philadelphia, Pa.	May 22, 1897	Do.	$13.75	June 7, 1897	June 1, 1897	Nov. 30, 1897

a Contract completed.

COMMERCIAL STATISTICS.

The improvement of this channel is not of a local character. A large number of vessels go through the thoroughfare annually, using it as a sheltered route in bad weather and for refuge during storms. In 1896, 1,625 cargoes, tonnage 275,000.

The following information in regard to the tonnage using the channel during the year 1897 is furnished by the deputy collector of customs at Jonesport:

Vessels loaded with piles	250
Vessels loaded with plaster	150
Vessels loaded with stone	250
Vessels loaded with lumber	250
Vessels loaded with general merchandise	175
Vessels loaded with coal	50
Fishing vessels	325
Vessels in ballast	850
Steamers, passenger	450

A 3.

IMPROVEMENT OF NARRAGUAGUS RIVER, MAINE.

The approved project and the report of progress of the work up to June 30, 1897, will be found in the Report of the Chief of Engineers for 1898, Part I, page 38.

The expenditures during the fiscal year 1898 were $4,664.23. No work was done. The expenditures consisted in payment for work under a contract completed about the close of the fiscal year 1897.

The improvement is in the collection district of Machias. The nearest port of entry is Machias. The nearest light-house is Narraguagus Light-House, on Pond Island.

Money statement.

July 1, 1897, balance unexpended	$5,261.17
June 30, 1898, amount expended during fiscal year	4,664.23
July 1, 1898, balance unexpended	596.94
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

APPROPRIATIONS.

For improvement above Millbridge:		
Act of March 3, 1871	$12,000	
Act of June 10, 1872	10,000	
		$22,000
For improvement below Millbridge:		
Act of August 5, 1886	10,000	
Act of August 11, 1888	10,000	
Act of September 19, 1890	7,500	
Act of July 13, 1892	7,500	
Act of August 18, 1894	5,000	
Act of June 3, 1896	5,000	
		45,000
Total		67,000

COMMERCIAL STATISTICS.

Receipts and shipments.

	Tons.
1891	48,959
1892	45,300
1893	60,875
1894	95,600
1895	54,750
1896	16,175

1897:	Tons.
Coal	1,000
Fish and salt	1,700
Hardware and iron	300
Lumber	12,000
Miscellaneous	25,000
Stone and silica	1,500
Total	41,500

Arrivals and departures in calendar year 1897.

Steamers:	
Coastwise, average draft 9 feet	156
Sailing vessels:	
Foreign, average draft 8½ feet	4
Coastwise, average draft 8½ feet	716
Built, tonnage about 500	1

A 4.

BREAKWATER FROM MOUNT DESERT TO PORCUPINE ISLAND, BAR HARBOR, MAINE.

The approved project and the report of progress of the work up to June 30, 1897, will be found in the report of the Chief of Engineers for 1898, Part I, page 38.

The expenditures during the fiscal year 1898 were $34.63. No work was done, the appropriation being exhausted.

Bar Harbor is in the collection district of Frenchman Bay. The nearest port of entry is Ellsworth. The nearest light-house is on Egg Rock, 3½ miles distant.

Money statement.

July 1, 1897, balance unexpended	$544.03
June 30, 1898, amount expended during fiscal year	34.63
July 1, 1898, balance unexpended	509.40
Amount (estimated) required for completion of existing project	250,200.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

APPROPRIATIONS.

August 11, 1888	$50,000
September 19, 1890	50,000
July 13, 1892	50,000
August 18, 1894	10,000
June 3, 1896	10,000
Total	170,000

COMMERCIAL STATISTICS.

No statement of tonnage could be obtained, but there has been no great change in the conditions.

The traffic is chiefly the transportation of passengers and supplies.

A 5.

IMPROVEMENT OF HARBOR AT SULLIVAN FALLS, MAINE.

The approved project and the report of progress of the work to June 30, 1897, will be found in the Report of the Chief of Engineers for 1898, Part I, page 39.

The expenditures during the fiscal year 1898 were $4,834.11. The operations consisted in removing a portion of Hatchers Rock to a depth of 10 feet at mean low tide under a contract with William D. Johnston. Work was commenced in August, 1897, and the contract was completed during the following October. The entire quantity of ledge removed to the specified depth was about 415 cubic yards, removing nearly the entire area of Hatchers Rock to the specified depth.

Sullivan Falls is in the collection district of Frenchman Bay. The nearest lighthouse is Crabtree Ledge light station.

Money statement.

July 1, 1897, balance unexpended	$5,000.00
June 30, 1898, amount expended during fiscal year	4,834.11
July 1, 1898, balance unexpended	165.89
Amount (estimated) required for completion of existing project	30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

APPROPRIATIONS.

Act of March 3, 1871	$10,000	
Act of June 10, 1872	25,000	
		$35,000
Act of June 3, 1896		5,000
Total		40,000

Contract in force during the fiscal year ending June 30, 1898.

No.	Contractor.	Date.	Subject.	Price per cubic yard.	Date of approval.	Beginning of work.	Expiration.
1	William D. Johnston, Philadelphia, Pa.	May 22, 1897	Removal of ledge.	$16.48	June 7, 1897	June 1, 1897	Nov. 30, 1897

Contract completed.

COMMERCIAL STATISTICS.

Receipts and shipments.

	Tons.
1896	51,290
1897:	
Coal	190
Granite and paving blocks	46,600
General merchandise	1,500
1897—Continued:	
Hay and grain	1,500
Lumber and wood	1,000
Total	50,790

Arrivals and departures in calendar year 1897.

Sailing vessels, average 233 tons 215

A 6.

IMPROVEMENT OF UNION RIVER, MAINE.

The approved project and the report of progress of the work to June 30, 1897, will be found in the Report of the Chief of Engineers for 1898, Part I, page 40.

The expenditures during the fiscal year 1898 were $609.05. The operations consisted in dredging, under a contract with Eastern Dredging Company. The work was commenced May 12, 1898, and by the close of the year dredging had advanced to a point about 3,000 feet from the lower end of the dredged channel working upstream, but a section of about 1,000 feet, where harder material was encountered, was not down to grade.

Union River is in the collection district of Frenchman Bay. The nearest lighthouse is Blue Hill Bay Light.

Money statement.

July 1, 1897, balance unexpended		$15,000.00
June 30, 1898, amount expended during fiscal year		609.05
July 1, 1898, balance unexpended		14,390.95
July 1, 1898, outstanding liabilities	$125.00	
July 1, 1898, amount covered by uncompleted contracts	13,680.00	
		13,805.00
July 1, 1898, balance available		585.95
Amount (estimated) required for completion of existing project		130,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900		60,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

APPROPRIATIONS.

July 11, 1870	$15,000	
March 3, 1871	15,000	
		$30,000
June 3, 1896		15,000
Total		45,000

Abstract of proposal for dredging, July 21, 1897.

No.	Bidder.	45,000 cubic yards (price per cubic yard, scow measurement).	Amount.
		Cents.	
1	Eastern Dredging Co., Boston, Mass	48	$21,600

Bid rejected as being too high.

Abstract of proposal for dredging, August 26, 1897.

No.	Bidder.	45,000 cubic yards (price per cubic yard, scow measurement).	Amount.
		Cents.	
1	Eastern Dredging Co., Boston, Mass	38	$17,100

Contract made with Eastern Dredging Company, September 20, 1897.

Contract in force during the fiscal year ending June 30, 1898.

No.	Contractor.	Date.	Subject.	Price per cubic yard.	Date of approval.	Beginning of work.	Expiration.
				Cents.			
1	Eastern Dredging Co., Boston, Mass.	Sept. 20, 1897	Dredging channel.	38	Oct. 6, 1897	May 13, 1898	Oct. 13, 1898

COMMERCIAL STATISTICS.

Receipts and shipments.

	Tons.
1896	54,000
1897:	
Bricks	500
Coal	3,000
Cement and lime	200
Fish	200
General merchandise	5,000
1897—Continued.	
Hardware and iron	200
Lumber, staves, shingles, etc.	45,000
Powder	10
Roofing gravel	200
Wood	3,375
Total	57,685

Arrivals and departures in calendar year, 1897.

Sailing vessels, average draft, 10½ feet, average tonnage, 150	500
Steamboat line established between Union River and Rockland:	
Steamer, 161 tons	1
Steamer, 132 tons	1
Steamer, 71 tons	1

A 7.

IMPROVEMENT OF BAGADUCE RIVER, MAINE.

The approved project and the report of progress of the work to June 30, 1897, will be found in the Report of the Chief of Engineers for 1898, Part I, page 40.

The expenditures during the fiscal year 1898 were $4,765.34. The operations consisted in removing bowlders, under a contract with Robert H. Rogers. The work was commenced during the latter part of August. The contract was completed on the 5th of the following October, when 446.7 tons of bowlders had been removed from the channel at Winslows Island.

The improvement is in the collection district of Castine. The nearest port of entry is Castine, at the mouth of the river. The nearest light-house is at Dice Head.

Money statement.

July 1, 1897, balance unexpended	$4,975.16
June 30, 1898, amount expended during fiscal year	4,765.34
July 1, 1898, balance unexpended	209.82
Amount (estimated) required for completion of existing project	24,875.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	24,875.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

APPROPRIATIONS.

August 11, 1888	$3,000
September 19, 1890	4,000
July 13, 1892	5,000
August 18, 1894	5,000
June 3, 1896	5,000
Total	22,000

Abstract of proposal for removing bowlders, July 21, 1897.

No.	Bidder.	Approximate quantity, 100 tons (price per ton).	Amount.
1	Robert H. Rogers, Plattsburg, N. Y.	$9.87	$987.00

Contract made with Robert H. Rogers, September 7, 1897.

Contract in force during the fiscal year ending June 30, 1898.

No.	Contractor.	Date.	Subject.	Price per ton for removing bowlders.	Date of approval.	Beginning of work.	Expiration.
1	Robert H. Rogers, Plattsburg, N. Y.	Sept. 7, 1897	Removing bowlders.	$9.87	Oct. 6, 1897	Aug. 23, 1897	Nov. 22, 1897

Contract completed.

COMMERCIAL STATISTICS.

Receipts and shipments.

	Tons.
1891	41,300
1892	46,100
1893	49,300
1894	67,850
1895	85,900
1896	78,050
1897:	
Bricks	7,300
Coal	2,500
Cotton	300
Farm produce	350
1897—Continued.	
Fish	300
Grain	11,000
General merchandise	25,000
Granite	5,000
Ice	450
Lumber and cooperage	16,200
Lime, cement, etc	12,000
Phosphate	200
Wood	6,000
Total	86,600

Arrivals and departures in calendar year 1897.

Steamers drawing 10 feet or more, 500 to 1,500 tons	400
Steamers drawing less than 10 feet, 5 to 250 tons	1,000
Sailing vessels drawing 10 feet or more, 150 to 400 tons	180
Sailing vessels drawing less than 10 feet, 5 to 150 tons	500
Steam tugs plying on the river	1

Most of the foregoing includes receipts and shipments at Castine, at the mouth of the river.

A 8.

IMPROVEMENT OF PENOBSCOT RIVER, MAINE.

The approved project and the report of progress of the work to June 30, 1897, will be found in the Report of the Chief of Engineers for 1898, Part I, page 41.

The expenditures during the fiscal year 1898 were $1,017.14. No work was done. The only operations consisted in an examination of a wreck during November, 1897, reported as an obstruction in the river near Hampden.

No appropriation is asked for further work under the present project. A proposed extension of the project is contained in the report of a recent survey in the vicinity of Bangor. (House Ex. Doc. No. 49, Fifty-first Congress, first session.)

Money statement.

July 1, 1897, balance unexpended	$10,033.14
June 30, 1898, amount expended during fiscal year	1,017.14
July 1, 1898, balance unexpended	9,016.00
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	290,000.00

APPROPRIATIONS.

March 2, 1829 (for survey)	$300
July 11, 1870 (at Bangor and below)	15,000
March 3, 1871 (at Bangor and below)	50,000
June 10, 1872	40,000
March 3, 1873	20,000

June 23, 1874	$20,000
March 3, 1875 ($10,000 to be expended at or near Bucksport Narrows)	25,000
August 14, 1876 ($4,000 to be expended at or near Bucksport Narrows)	10,000
June 18, 1878 ($2,500, or so much thereof as necessary, to be expended at or near Bucksport Narrows)	12,000
March 3, 1879	6,000
July 5, 1884 (for Bangor Harbor and Penobscot River)	20,000
August 5, 1886 (for widening channel at Bangor and removing obstructions near Crosbys Narrows)	15,000
August 11, 1888 ($20,000 to be expended between Bangor and Crosbys Narrows and $30,000 between Bucksport and Winterport)	50,000
September 19, 1890 (for continuing improvement and for dredging near Sterns's mill)	25,000
July 13, 1892	40,000
Total	348,300

COMMERCIAL STATISTICS.

Receipts and shipments.

	Tons.
1891	931,780
1892	714,935
1893	565,887
1894	750,313
1895	617,859
1896	715,911
1897:	
Brimstone	2,520
Bricks	1,640
Coal	172,683
Fertilizer and plaster rock	4,326
Flour, grain, and feed	20,336
General merchandise	29,500
Hay and wood	8,000
1897—Continued.	
Iron, castings, etc	1,232
Ice	211,136
Lime and cement	3,214
Lumber	284,035
Molding sand and potters clay	3,580
Oil	6,500
Paving stone, granite and slate	12,000
Salt	1,002
Spool wood and shooks	23,723
Wood pulp and paper	5,271
Total	790,698

Arrivals and departures in calendar year 1897.

Foreign:	
Steamships drawing over 20 feet, 1,000 to 2,000 tons	28
Sailing vessels *	49
Coastwise:	
Steamers *	968
Sailing vessels *	3,341
Total	4,386

A 9.

IMPROVEMENT OF HARBOR AT ROCKLAND, MAINE.

The approved project and the report of progress of the work to June 30, 1897, will be found in the Report of the Chief of Engineers for 1898, Part I, page 42.

The expenditures during the fiscal year 1898 were $30,565.35. The operations during the fiscal year consisted in the extension of the break-

* Draft and tonnage not known. Collector of customs states that many of the largest four-masted schooners afloat bring cargoes to the city of Bangor.

water, under contract with Charles H. Souther, which was in progress at the end of the fiscal year 1897. At the close of the fiscal year 1898 the contractor has deposited 73,950 tons of stone, rather less than one-quarter of the total quantity covered by his contract. The completed section of the breakwater has been extended out to a point 2,990 feet from the shore.

In April, 1898, proposals were opened for dredging and also for removal of the two groups of ledges which obstruct the harbor, or, in other words, for all the work covered by the project, except the breakwater, which was already under contract. The lowest bidders for the dredging were Moore & Wright, of Portland, Me., at 14 cents per cubic yard, place measurement; and for removing ledges (covering about 30,000 cubic yards), Dunbar & Sullivan, of Buffalo, N. Y., at $6.75 per cubic yard for Ledges A, B, and C (about 11,000 cubic yards) and $6.25 per cubic yard for Ledges D and E (about 19,000 cubic yards). Both of these bids were accepted, but no work has yet been done.

The amount (estimated) required for completion of existing project is predicated upon the original estimate and subsequent appropriations. At present contract rates this amount will be very much reduced, and taking into account the appropriation of $300,000 for this work carried in the sundry civil act of July 1, 1898, sufficient funds are now available for expenditure in the fiscal year ending June 30, 1900. For this reason no appropriation is asked for that fiscal year. It is not probable that such appropriation would be needed, even if work had to be readvertised and let at higher rates; but if such should be the case, a report of the fact will be promptly submitted.

Rockland is in the collection district of Waldoboro. There is a light on the end of the breakwater.

Money statement.

July 1, 1897, balance unexpended		$374,999.52
Amount appropriated by sundry civil act approved July 1, 1898		300,000.00
		674,999.52
June 30, 1898, amount expended during fiscal year		30,565.35
July 1, 1898, balance unexpended		644,434.17
July 1, 1898, outstanding liabilities	$2,907.06	
July 1, 1898, amount covered by existing contracts	181,479.35	
		184,386.41
July 1, 1898, balance available		460,047.76
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		110,500.00

APPROPRIATIONS.

June 14, 1880	$20,000	August 18, 1894	$30,000
August 2, 1882	40,000	June 3, 1896	25,500
July 5, 1884	40,000	June 4, 1897	350,000
August 5, 1886	22,500	July 1, 1898	300,000
August 11, 1888	30,000		
September 19, 1890	37,500	Total	925,500
July 13, 1892	30,000		

Abstract of proposals for ledge excavation, April 9, 1898.

No.	Bidders.	Ledges A, B, and C, 11,150 cubic yards in place (price per cubic yard).	Ledges D and E, 19,030 cubic yards in place (price per cubic yard).	Amount.
1	Charles W. Johnston, Philadelphia, Pa	$9.15	$9.75	$287,565.00
2	Jonn J. Fitzpatrick, Platteburg, N. Y	8.88	10.00	289,312.00
3	Isaac T. Brown, New York, N. Y	20.00	18.00	565,540.00
4	William S. White, Rockland, Me	12.50	12.50	377,250.00
5	Glover & Spear, Rockland, Me	7.52	7.58	228,095.40
6	Dunbar & Sullivan, Buffalo, N. Y	6.75	6.25	194,200.00
7	P. Sanford Ross, Incorporated, Jersey City, N. J	8.50	9.29	271,563.70

Proposal of Dunbar & Sullivan accepted.

Abstract of proposals for dredging and removing bowlders, April 9, 1898.

No.	Bidders.	471,286 cubic yards dredging (price per cubic yard in place).	Bowlders exceeding 5 tons (price per ton).	Amount.
		Cents.		
1	Charles H. Souther, Boston, Mass	17½	$5.00	$84,242.37
2	Virginia Dredging Co., Richmond, Va	14 3/16	3.00	70,221.61
3	Moore & Wright, Portland, Me	14	5.00	65,980.04

Contract made with Moore & Wright, May 16, 1898.

List of contracts in force during the fiscal year ending June 30, 1898.

No.	Contractors.	Date.	Subject.	Prices.	Date of approval.	Beginning of work.	Expiration.
1	Charles H. Souther, Boston, Mass.	May 4, 1897	Constructing breakwater.	59.3c. per ton for stone.	May 24, 1897	June 1, 1897	June 30, 1898
2	Moore & Wright, Portland, Me.	May 16, 1898	Dredging.	14c. per cubic yard.	June 8, 1898	June 6, 1898	Dec. 5, 1899
			Removing bowlders.	$5 per ton.	.....	.....	

COMMERCIAL STATISTICS.

Receipts and shipments.

	Tons.
1891	433,760
1892	526,805
1893	538,506
1894	509,853
1895	615,830
1896	580,295
1897:	
Bricks, cement and sand	30,540
Coal	58,400
Fish and salt, etc	10,000
Grain and flour	13,240
General merchandise	68,500
1897—Continued:	
Hay and straw	525
Ice	5,500
Lumber and ship timber	25,340
Lime	122,400
Oil	687
Stone	53,135
Sawdust and ashes	4,500
Steel rails, ironwork, and castings	2,025
Wood and cooperage	200,150
Total	594,992

Arrivals in calendar year 1897.

Steamers:	
Coastwise, 400 to 1,500 tons each	625
Coastwise, 25 to 400 tons each	2,148
Coastwise, under 25 tons each	272
Sailing vessels:	
Foreign (tonnage not stated)	362
Coastwise trade (tonnage not stated)	4,025
For refuge only	1,120

A 10.

IMPROVEMENT OF CARVERS HARBOR, VINALHAVEN, MAINE.

The approved project and the report of progress of the work to June 30, 1897, will be found in the Report of the Chief of Engineers, for 1898, Part I, page 44.

The expenditures during the fiscal year 1898 were $9,670.95. The operations consisted in dredging, under contract with Moore & Wright. The work was commenced October 11, 1897, and the contract was completed on the 8th of January, 1898, when 60,000 cubic yards of material had been removed. An area 680 feet wide and of an average length of about 600 feet, at the lower end of the inner harbor, was dredged to the projected depth of 16 feet at mean low tide. No work has been done since.

Carvers Harbor is in the collection district of Belfast. The nearest lighthouse is Heron Neck.

Money statement.

July 1, 1897, balance unexpended	$10,000.00
June 30, 1898, amount expended during fiscal year	9,670.95
July 1, 1898, balance unexpended	329.05
Amount (estimated) required for completion of existing project	54,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	54,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

APPROPRIATION.

June 3, 1896 ..... $10,000

Abstract of proposals for dredging, July 21, 1897.

No.	Bidders.	75,000 cubic yards (price per cubic yard measured in scow).	Amount.
		Cents.	
1	Moore & Wright, Portland, Me	15	$11,250
2	Charles H. Souther, Boston, Mass	17	12,750

Contract made with Moore & Wright, September 2, 1897.

Contract in force during the fiscal year ending June 30, 1898.

No.	Contractor.	Date.	Subject.	Price per cubic yard.	Date of approval.	Beginning of work.	Expiration
				Cents.			
1	Moore & Wright, Portland, Me.	Sept. 2, 1897	Dredging.	15	Sept. 27, 1897	Nov. 12, 1897	Feb. 23, 1898

Contract completed.

COMMERCIAL STATISTICS.

Receipts and shipments.

	Tons.
1896	63,078
1897:	
Coal, hay, wood, lumber, and general merchandise	9,180
Fish, salt, ice, bait, etc	10,000
1897—Continued.	
Lobsters	400
Stone	44,124
Total	63,704

Arrivals and departures in calendar year 1897.

Sailing vessels:	
Draft 9 to 18 feet, 100 to 400 tons	182
Draft 7 to 14 feet, 7 to 200 tons	518
Sailing vessels and boats, draft 4 to 8 feet, 5 to 12 tons	100
Vessels for refuge	450

A 11.

IMPROVEMENT OF GEORGES RIVER, MAINE.

The approved project and the report of progress of the work to June 30, 1897, will be found in the Report of the Chief of Engineers for 1898, Part I, page 45.

The expenditures during the fiscal year 1898 were $9,728.62. The operations consisted in dredging, under a contract with Hamilton & Sawyer. The work was commenced July 22, 1897, and the contract was completed on the 28th of the following September, the total quantity of material removed being 59,994 cubic yards. The work under this contract is the first done under the existing project, and has resulted in giving the full depth and width for a distance of about 2,100 feet up from the 16-foot contour.

Georges River is in the collection district of Waldoboro. The nearest light-house is Franklin Island.

Money statement.

July 1, 1897, balance unexpended	$10,000.00
June 30, 1898, amount expended during fiscal year	9,728.62
July 1, 1898, balance unexpended	271.38
Amount (estimated) required for completion of existing project	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

APPROPRIATION.

Act of June 3, 1896 ..... $10,000

Contract in force during the fiscal year ending June 30, 1898.

No.	Contractor.	Date.	Subject.	Price per cubic yard scow measure.	Date of approval.	Beginning of work.	Expiration.
				Cents.			
1	Hamilton & Sawyer, Portland, Me.	May 3, 1897	Dredging channel.	14.7	May 20, 1897	July 20, 1897	Oct. 20, 1897

Contract completed.

COMMERCIAL STATISTICS.

Receipts and shipments.

	Tons.
1896	45,375
1897:	
Bricks	900
Coal	7,000
Cement and general merchandise	1,500
1897—Continued.	
Farm products and grain	1,150
Lime	31,200
Wood	22,500
Total	64,250

Arrivals and departures in calendar year 1897.

Sailing vessels, coastwise:	
Drawing 10 feet or more, average 350 tons	330
Drawing less than 10 feet, 75 to 350 tons	30
Sailing vessels, foreign, average 100 tons	32
Barges, 25 to 50 tons	40
Vessels in process of construction, 1,000 to 1,200 tons	2

A 12.

IMPROVEMENT OF KENNEBEC RIVER, MAINE.

The approved project and the report of progress of the work to June 30, 1897, will be found in the Report of the Chief of Engineers for 1898, Part I, page 45.

The expenditures during the fiscal year, 1898, were $15,448.99. The operations consisted in dredging Gages Shoal, near Augusta, under contract with Moore & Wright. Work was commenced September 29, 1897, and was in progress at the close of the fiscal year, the contract being nearly completed. This is the last work to be done under the existing project and will complete it unless new conditions develop.

No further appropriation is asked for the present.

The improvement is in the collection district of Bath, of which Bath is the port of entry. Fort Popham and the light-house on Pond Island are near the mouth of the river.

Money statement.

July 1, 1897, balance unexpended		a$52,244.57
June 30, 1898, amount expended during fiscal year		15,448.99
July 1, 1898, balance unexpended		36,795.58
July 1, 1898, outstanding liabilities	$1,921.92	
July 1, 1898, amount covered by uncompleted contracts	7,851.60	
		9,773.52
July 1, 1898, balance available		27,022.06
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		58,500.00

APPROPRIATIONS.

March 2, 1827	$4,000	June 23, 1874	$12,000
March 19, 1828	3,500	March 3, 1875	15,000
April 23, 1830	5,000	March 3, 1881	10,000
August 30, 1852	6,000	August 11, 1888	75,000
June 23, 1866	20,000	September 19, 1890	50,000
March 2, 1867	30,000	July 13, 1892	100,000
April 10, 1869	14,850	August 18, 1894	50,000
July 11, 1870	15,000	June 3, 1896	55,000
March 3, 1871	15,000		
June 10, 1872	8,000	Total	500,350
March 3 1873	12,000		

Abstract of proposals for dredging and removing bowlders, July 21, 1898.

No.	Bidders.	45,000 cubic yards (Gages Shoal), price per cubic yard measured in scow.	Removing bowlders, price per ton.	Amount.
		Cents.		
1	Robert H. Rogers, Plattsburg, N. Y.	.....	$19	.....
2	Moore & Wright, Portland, Me.	75	10	$33,750

All bids rejected as being too high.

Abstract of proposals for dredging and removing bowlders, August 26, 1898.

No.	Bidders.	45,000 cubic yards (Gages Shoal), price per cubic yard measured in scow.	Removing bowlders, price per ton.	Amount.
		Cents.		
1	Moore & Wright, Portland, Me	40	$10	$18,000

Contract made with Moore & Wright, October 25, 1897.

a Differs from last year's report by $2.02, being amount of Treasury settlement for telegrams, made in December, 1896.

Contract in force during the fiscal year ending June 30, 1898.

No.	Contractor.	Date.	Subject.	Prices.	Date of approval.	Beginning of work.	Expiration.
1	Moore & Wright, Portland, Me.	Oct. 25, 1897	Dredging channel at Gages Shoal. Removing bowlders.	40 cents per cubic yd. $10 per ton.	Nov. 4, 1897	Nov. 3, 1897	Aug. 3, 1898

COMMERCIAL STATISTICS.

Receipts and shipments.

	Tons.
1891	1,210,474
1892	1,263,145
1893	970,938
1894	1,207,965
1895	1,162,972
1897:	
Bricks	1,462
Coal	85,044
Cement and plaster	270
General merchandise	9,130
Grain and hay	602
1897—Continued.	
Iron, machinery and castings	1,691
Ice	481,000
Lime and fertilizers	2,293
Lumber and ship timbers	53,880
Molding sand	880
Stone	25,000
Salt	600
Sulphur, alum, and paper	2,001
Wood	2,138
Total	665,991

Arrivals and departures in calendar year, 1897.

Coastwise:	
Steamers, about 1,600 tons each	565
Steamers, about 100 tons and less each	605
Sailing vessels, average 400 tons each	3,492
Foreign:	
Sailing vessels, average 400 tons each	125
Total	4,787
Tugs plying on the river	16
Ferryboats plying on the river	2
Vessels built during the year, tonnage 5,155	7

A 13.

IMPROVEMENT OF SASANOA RIVER, MAINE.

The approved project and the report of progress of the work to June 30, 1897, will be found in the Report of the Chief of Engineers, for 1898, Part I, page 46.

The expenditures during the fiscal year 1898, were $11,548.62. The operations consisted in removal of ledge at Upper Hell Gate, dredging a small shoal at Carletons Ledges, and erecting a beacon on the jetty at Camp Ground.

Removal of ledge at Hell Gate, under contract with Robert H. Rogers, which was in progress at the close of the last fiscal year, was completed early in March, 1898, about 796 cubic yards of material being removed. The small shoal at Carletons Ledges was removed during September, 1897, the quantity of material removed being 955 cubic yards. A beacon on the end of the jetty at Camp Ground was constructed during November, 1897.

The project is completed.

The improvement is in the collection district of Bath. The nearest light-house is on Hendricks Head.

Money statement.

July 1, 1897, balance unexpended	$18,560.93
June 30, 1898, amount expended during fiscal year	11,548.62
July 1, 1898, balance unexpended	7,012.31

APPROPRIATIONS.

July 11, 1870	$10,000	March 3, 1881	$5,000
March 3, 1871	6,500	June 3, 1896	19,000
June 18, 1878	17,000		
June 14, 1880	7,000	Total	64,500

Abstract of proposal for dredging, July 21, 1897.

No.	Bidder.	2,000 cubic yards (price per cubic yard, scow measure).	Amount.
1	Moore & Wright, Portland, Me	*Cents.* 25	$500

Bid rejected as being too high.

Abstract of proposal for dredging, August 26, 1897.

No.	Bidder.	2,000 cubic yards (price per cubic yard, scow measure).	Amount.
1	Moore & Wright, Portland, Me	*Cents.* 25	$500

Contract made with Moore & Wright, September 30, 1897.

List of contracts in force during the fiscal year ending June 30, 1898.

No.	Contractors.	Date.	Subject.	Price per cubic yard.	Date of approval.	Beginning of work.	Expiration.
a 1	Robert H. Rogers, Plattsburg, N. Y.	May 3, 1897	Excavation of ledge.	$10.48	May 20, 1897	May 1, 1897	May 31, 1898
a 2	Moore & Wright, Portland, Me.	Sept. 30, 1897	Dredging	.25	Oct. 6, 1897	Oct. 4, 1897	Dec. 4, 1897

a Contract completed.

COMMERCIAL STATISTICS.

It was impracticable to obtain complete commercial statistics for the river. The following information has been furnished by the Eastern Steamboat Company:

Passengers and freight steamers plying on the river	8
Passengers carried, about	45,000
Amount of freight ..... tons	1,500
Trips between Bath and Boothbay, daily	14

A large number of steam yachts use this river.

A 14.

IMPROVEMENT OF PORTLAND HARBOR, MAINE.

The approved project and the report of progress of the work to June 30, 1897, will be found in the Report of the Chief of Engineers for 1898, Part I, page 47.

The expenditures during the fiscal year 1898 were $56,088.05. The operations consisted in dredging, under a contract with George M. Valentine & Co., for doing all the work covered by the present project. The first dredging was done July 2, 1897, and by the close of the fiscal year there had been removed 608,462 cubic yards measured in place. By the removal of this quantity of material an area in the front harbor in front of the Grand Trunk Wharves, about 2,100 feet long and 700 feet wide, was dredged to the depth of 30 feet at mean low tide. In Back Cove the channel was dredged to its full dimensions except in the upper portion where shoaling has occurred, and which is now being redredged.

The amount (estimated) required for completion of existing project is predicated upon the original estimate and subsequent appropriations. At present contract rates this amount will be very much reduced and taking into account the appropriation of $200,000 for this work carried in the sundry civil act of July 1, 1898, sufficient funds are now available for expenditure in the fiscal year ending June 30, 1900. For this reason no appropriation is asked for that fiscal year. It is not probable that such appropriation would be needed even if work had to be readvertised and let at higher rates; but if such should be the case, a report of the fact will be promptly submitted.

The harbor is defended by Forts Preble, Gorges, Scammel, and a battery at Portland Head. There is a light-house on the breakwater and one at Portland Head, 3 miles distant from the city. The harbor is in the collection district of Portland and Falmouth, of which Portland is the port of entry.

Money statement.

July 1, 1897, balance unexpended		$368,560.43
Amount appropriated by sundry civil act approved July 1, 1898		200,000.00
		568,560.43
June 30, 1898, amount expended during fiscal year		56,088.05
July 1, 1898, balance unexpended		512,472.38
July 1, 1898, outstanding liabilities	$6,741.46	
July 1, 1898, amount covered by uncompleted contracts	467,182.29	
		473,923.75
July 1, 1898, balance available		38,548.63
Amount (estimated) required for completion of existing project ..... Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		460,000.00

APPROPRIATIONS.

July 4, 1836, for breakwater	$10,000.00
March 3, 1837, for breakwater	25,000.00
July 7, 1838, for breakwater	26,366.00
June 23, 1866, for extending breakwater, but unexpended balance made available for excavating middle ground by joint resolution of June 5, 1868	105,111.05
July 11, 1870, for improving harbor	10,000.00
March 3, 1871, for improving harbor	40,000.00
June 10, 1872, for improving Portland Harbor and Back Bay	45,000.00
March 3, 1873, for improving harbor	50,000.00
June 23, 1874, for improving harbor	20,000.00
March 3, 1875, for improving harbor	20,000.00
March 3, 1881, for improving harbor	20,000.00
August 2, 1882, for improving harbor	35,000.00
July 5, 1884, for improving harbor	30,000.00
August 5, 1886, for improving harbor	30,000.00
August 5, 1886, for Back Cove	26,250.00
August 11, 1888, for improving harbor	40,000.00
August 11, 1888, for Back Cove	25,000.00
September 19, 1890, for improving harbor	40,000.00
September 19, 1890, for Back Cove	25,000.00
July 13, 1892, for improving harbor	30,000.00
July 13, 1892, for Back Cove	20,000.00
August 18, 1894, for Back Cove	20,000.00
June 3, 1896	20,000.00
June 4, 1897	350,000.00
July 1, 1898	200,000.00
Total	1,262,727.05

Contract in force during the fiscal year ending June 30, 1898.

No.	Contractor.	Date.	Subject.	Price per cubic yard in place.	Date of approval.	Beginning of work.	Expiration.
1	Geo. M. Valentine & Co., New York, N. Y.	June 4, 1897	Dredging	*Cents.* a 9.98 b 20	June 22, 1897	June 1, 1897	Fixed by rate of progress prescribed in the contract.

a Plan B and Back Cove. b For 29 foot area.

COMMERCIAL STATISTICS.

Receipts and shipments

	Tons.
1891	1,368,237
1892	1,376,815
1893	1,432,805
1894	1,214,887
1895	1,339,064
1896	1,357,575
1897:	
Apples and citrons fruits.	1,466
Bacon, flour, and provisions	60,845
Bricks, stone, molding sand, and clay	27,177
Coal and wood	558,971
Cattle on hoof	1,504
Cement, lime and pipe, etc.	19,078
Cotton and sisal	4,634
1897—Continued.	
Cooperage and lumber, etc.	73,751
Fish and salt	57,485
General merchandise and dry goods	300,555
Grain, feed, and hay	112,793
Ice	15,000
Iron, lead, machinery, and tin	1,161
Molasses and sugar	17,197
Oils, paints, brimstone, china clay, and printing paper	75,227
Total	1,326,844

Steamers:	
Coastwise, drawing 12 to 18 feet, average 1,200 tons	793
Coastwise, drawing 8½ feet, average 210 tons	200
Coastwise, drawing 9½ feet, average 150 tons	810
Coastwise, drawing 6 feet, average 42 tons	360
Foreign, drawing 18 to 25 feet, average 3,000 tons	73
Foreign, drawing 12 to 18 feet, average 1,200 tons	333
For refuge	50
Sailing vessels:	
Foreign, drawing 10 to 16 feet, 250 to 1,000 tons	181
Coastwise, drawing 10 to 16 feet, 250 to 1,000 tons	284
Coastwise, drawing about 10 feet, average 800 tons	2,000
Coastwise, drawing less than 10 feet, average 150 tons	1,500
For refuge	1,200
Coastwise, drawing 12 to 18 feet, over 1,000 tons	79

A 15.

IMPROVEMENT OF SACO RIVER, MAINE.

The approved project and the report of progress of the work to June 30, 1897, will be found in the Report of the Chief of Engineers for 1898, Part I, page 49.

The expenditures during the fiscal year 1898 were $7,030.91. The operations consisted in raising the shore end of the breakwater on the north side of the mouth of the river, under contract with George Willett Andrews. The work was commenced about the last of August, 1897, and was completed on the 11th of the following December. The total quantity of stone furnished was 5,200 tons, with which the breakwater was brought to the full section for a distance of 750 feet. The only other work proposed for the completion of this project will be any needed repairs to the jetty on the south side of the mouth of the river.

Saco is in the collection district of Saco, Me., of which Saco is the port of entry. The nearest light-house is on Wood Island.

Money statement.

July 1, 1897, balance unexpended	$10,376.55
June 30, 1898, amount expended during fiscal year	7,030.91
July 1, 1898, balance unexpended	3,345.64
Amount (estimated) required for completion of existing project	52,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

APPROPRIATIONS.

March 2, 1827, for piers, buoys, and removing obstructions at and near entrance	$7,000
June 23, 1866, for repairing piers	40,000
March 2, 1867, for improving river	40,000
July 25, 1868, for improving river	20,000
April 10, 1869, for improving river	22,275
July 11, 1870, for improving river	10,000
March 3, 1871, for improving river	15,000
June 10, 1872, for improving river	15,000
July 5, 1884, for breakwater	15,000
August 5, 1886, for breakwater	12,500
August 5, 1886, for improving river	12,500
August 11, 1888, for breakwater	12,500
August 11, 1888, for improving river	10,000

September 19, 1890, for improving river, including breakwater and jetty	$65,000
July 13, 1892, for improving river, including breakwater	25,000
August 18, 1894, for improving river, including breakwater	10,000
June 3, 1896, for improving river, including breakwater	10,000
Total	341,775

Abstract of proposals for raising inner end of breakwater, July 21, 1897.

No.	Bidders.	4,000 tons stone (price per ton).	Amount.
1	Hamilton & Cleaves, Portland, Me	$2.48½	$9,940
2	George Willett Andrews, Biddeford, Me	1.01	4,040

Contract made with George Willett Andrews, September 3, 1897.

Contract in force during the fiscal year ending June 30, 1898.

No.	Contractor.	Date.	Subject.	Price per ton for stone.	Date of approval.	Beginning of work.	Expiration.
1	George Willett Andrews, Biddeford, Me.	Sept. 3, 1897	Raising inner end of breakwater.	$1.01	Oct. 1, 1897	Aug. 23, 1897	Dec. 11, 1897

Contract completed.

COMMERCIAL STATISTICS.

Receipts and shipments.

	Tons.
1891	49,765
1892	47,108
1893	59,765
1894	47,350
1895	62,129
1896	46,956

1897:	Tons.
Bricks	5,920
Coal	35,564
Iron	300
Molding sand	340
Roofing	90
Total	42,214

Arrivals and departures in calendar year 1897.

Sailing vessels, coastwise, average draft 11¼ feet, average 247 tons	128

A 16.

IMPROVEMENT OF COCHECO RIVER, NEW HAMPSHIRE.

The approved project and the report of progress of the work to June 30, 1897, will be found in the Report of the Chief of Engineers for 1898, Part I, page 50.

The expenditures during the fiscal year 1898 were $6,800.28. The operations consisted in excavating the channel through the ledge in

the Lower Narrows, under contract with Simon J. Donovan. Work was continued throughout the fiscal year, excepting while suspended for climatic reasons during the winter, and about 535 cubic yards of ledge have been removed. The work was still in progress at the close of the fiscal year 1898.

Money statement.

July 1, 1897, balance unexpended		$14,782.31
June 30, 1898, amount expended during fiscal year		6,800.28
July 1, 1898, balance unexpended		7,982.03
July 1, 1898, outstanding liabilities	$553.42	
July 1, 1898, amount covered by uncompleted contracts	5,715.75	
		6,269.17
July 1, 1898, balance available		1,712.86
Amount (estimated) required for completion of existing project		105,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900		50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

APPROPRIATIONS.

July 4, 1836	$5,000	July 5, 1884	$28,000
March 3, 1837	5,000	August 5, 1886	10,000
March 3, 1871	10,000	August 11, 1888	9,000
June 10, 1872	10,000	September 19, 1890	25,000
March 3, 1873	10,000	July 13, 1892	15,000
June 23, 1874	10,000	August 18, 1894	15,000
March 3, 1875	25,000	June 3, 1896	15,000
August 14, 1876	14,000		
June 18, 1878	6,000	Total	240,000
August 2, 1882	28,000		

Contract in force during the fiscal year ending June 30, 1898.

No.	Contractor.	Date.	Subject.	Price per cubic yard.	Date of approval.	Beginning of work.	Expiration.
1	Simon J. Donovan, Winthrop, Mass.	May 10, 1897	Removal of ledge.	$7.50	June 3, 1897	May 1, 1897	Sept. 30, 1898

COMMERCIAL STATISTICS.

Receipts and shipments.

	Tons.		Tons.
1891	70,662	1894	68,415
1892	71,785	1895	83,151
1893	66,933	1896	59,755

No statement of tonnage could be obtained for calendar year 1897.

A 17.

HARBOR OF REFUGE AT LITTLE HARBOR, NEW HAMPSHIRE.

The approved project and the report of progress of the work to June 30, 1897, will be found in the Report of the Chief of Engineers for 1898, Part I, page 51.

The expenditures during the fiscal year 1898 were $8,596.36. The operations consisted in dredging and in repair of the breakwater at Jerrys Point. The work of dredging, which was in progress at the close of the last fiscal year under contract with Charles H. Souther, was completed on the 14th of August, 1897, the total quantity of material removed under the contract being about 51,993 cubic yards, by which the anchorage was widened about 85 feet.

Under the contract with George Willett Andrews the repair of the breakwater at Jerrys Point, which had been damaged by storms, was commenced during December, 1897. The contract has not yet been finished, although the work is nearly completed.

Portsmouth is the nearest port of entry. There are defensive works at Jerrys Point, and there is a light at the end of each breakwater.

Money statement.

July 1, 1897, balance unexpended		$10,171.60
June 30, 1898, amount expended during fiscal year		8,596.36
July 1, 1898, balance unexpended		1,575.24
July 1, 1898, outstanding liabilities	$100.00	
July 1, 1898, amount covered by uncompleted contracts	1,277.02	
		1,377.02
July 1, 1898, balance available		198.22
Amount (estimated) required for completion of existing project		25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900		25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

APPROPRIATIONS.

August 5, 1886	$10,000	August 18, 1894	$10,000
August 11, 1888	20,000	June 3, 1896	10,000
September 19, 1890	40,000		
July 13, 1892	30,000	Total	120,000

Abstract of proposals for repairing breakwater, July 21, 1897.

No.	Bidder.	Replacing coping stones (lump sum).	Widening breakwater, 1,000 tons stone (price per ton).	Amount.
1	William S. White, Rockland, Me	$190	$3.15	$3,340
2	Hamilton & Cleaves, Portland, Me	952	2.58	3,532
3	George Willett Andrews, Biddeford, Me	200	1.85	2,050

Contract made with George Willett Andrews, September 3, 1897.

List of contracts in force during the fiscal year ending June 30, 1898.

No.	Contractor.	Date.	Subject.	Price.	Date of approval.	Beginning of work.	Expiration.
a 1	Charles H. Souther, Boston, Mass.	May 4, 1897	Dredging.	*b* $0.14¼	May 20, 1897	July 1, 1897	Dec. 1, 1897
2	George Willett Andrews, Biddeford, Me.	Sept. 3, 1897	Widening breakwater.	*c* 1.85	Oct. 6, 1897	Aug. 23, 1897	June 30, 1898
			Replacing coping stones.	*d* 200.00			

a Contract completed. *b* Per cubic yard. *c* Per ton stone. *d* Lump sum.

COMMERCIAL STATISTICS.

This harbor is used chiefly for refuge, there being no commerce belonging to it, and very little thereat.

The following information has been received from the keeper of the life-saving station at that locality:

	Tons.
17 coasting vessels, average draft 7 feet, average tonnage	90
40 fishing vessels, average draft 7 feet, average tonnage	35
35 steam yachts, average draft 7 feet, average tonnage	50
40 sailing yachts, average draft 7 feet, average tonnage	30

A large number of fishing boats entered Little Harbor for refuge during the calendar year 1897.

A 18.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

The schooner *L. Holway*, a small wooden vessel, was sunk in Narragaugus Bay May 30, 1896. The wreck was an obstruction to navigation, and in August, 1896, its removal was authorized. Mr. Henry M. Leighton, of Millbridge, Me., undertook to removed the wreck and destroy it for the sum of $160. This work was accomplished during the fiscal year 1898. The total cost in connection with this wreck has been $260.

The wreck of the schooner *Matilda*, a small wooden vessel, being an obstruction to navigation in Deer Island Thoroughfare, its removal was authorized in January, 1898. The work was advertised and a contract made with William S. White, of Rockland, Me. At the close of the fiscal year 1898 the wreck had been partly removed.

The schooner *Nevada*, a small wooden vessel, was wrecked in Davis Strait December 31, 1897. During a storm in the following January the wreck floated off the ledge and sunk across the channel, constituting an obstruction to navigation. Its removal was authorized in February, 1898. The work was advertised and a contract made with John F. Hamilton, under which the wreck has been taken up and removed.

Abstract of proposals for removing wreck of schooner Matilda, March 31, 1898.

No.	Bidders.	Price.
1	John F. Hamilton, Portland, Me	$500
2	John L. Goss, Stonington, Me	945
3	Scott Geyer, Stonington, Me	1,000
4	Philip H. Doyen, Knightsville, Me	490
5	D. A. Johnston, New York, N. Y	1,200
6	W. H. Simmons, Rockland, Me	597
7	William S. White, Rockland, Me	475
8	John L. Mills, Camden, N. J	1,147
9	James R. Rogers, Plattsburg, N. Y	869
10	Solon S. Andrews, Gorham, Me	485
11	Alfred Sorensen, Boston, Mass	1,200
12	William H. Virden and John C. Ross, Lewes, Del	890

Contract made with William S. White, May 9, 1898.

Abstract of proposals for removing wreck of schooner Nevada, April 12, 1898.

No.	Bidders.	Price.
1	Charles W. Johnston, Philadelphia, Pa	$375
2	William S. White, Rockland, Me	475
3	D. A. Johnston, New York, N. Y	800
4	John L. Mills, Camden, N. J	947
5	William Harrison Simmons, Rockland, Me	473
6	James S. Rogers, Plattsburg, N. Y	533
7	Solon S. Andrews, Gorham, Me	465
8	John F. Hamilton, Portland, Me	270
9	Philip H. Doyen, Knightsville, Me	619

Contract made with John F. Hamilton, May 10, 1898.

List of contracts in force during the fiscal year ending June 30, 1898.

No.	Contractor.	Date.	Subject.	Price.	Date of approval.	Beginning of work.	Expiration.
1	William S. White, Rockland, Me.	May 9, 1898	Removing wreck schooner Matilda.	$475	May 28, 1898	Regulated by time for completion.	30 days after notice of approval of contract.
a 2	John F. Hamilton, Portland, Me.	May 10, 1898	Removing wreck schooner Nevada.	270	June 2, 1898	.....do	Do.

a Contract completed.

A 19.

SURVEY OF UNION RIVER, MAINE, FOR A DEEPER AND BROADER CHANNEL.

[Printed in House Doc. No. 124, Fifty-fifth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 1, 1897.

SIR: I have the honor to submit the accompanying report of October 22, 1897, by Maj. R. L. Hoxie, Corps of Engineers, concerning a survey

of Union River, Maine, for a deeper and broader channel, under requirements of section 9 of the river and harbor act of June 3, 1896.

Under provisions of river and harbor act of June 3, 1896, a preliminary examination of this locality was made by Lieut. Col. A. N. Damrell, Corps of Engineers, report concerning which was submitted to Congress and printed as House Doc. No. 6, Fifty-fifth Congress, first session.

Major Hoxie states that he agrees with that officer in the opinion that the field work of additional surveys is unnecessary, the ground having been fully covered by a survey in 1890, and from that survey it appears that the sum of $225,000 is required to secure a channel 100 feet wide and 6 feet deep at low tide through the bar at the mouth of the river and through the narrows below Ellsworth, increasing to 150 feet in width in front of the wharves at Ellsworth. This estimate includes the construction of a jetty and training wall (the latter to be marked with three rough stone beacons), built to the height of 6 feet above mean high water, to preserve the channel over the bar after the dredging is completed.

Major Hoxie further states that the improvement of all rivers upon the coast of Maine is more or less interfered with by the practice of throwing mill refuse into them, and that in this connection it is proper to invite attention to the necessity for further legislation to prevent the deposit of mill waste and other refuse in these rivers.

The division engineer, Col. G. L. Gillespie, Corps of Engineers, in transmitting the report to this office, states as follows:

It appears from the report of Colonel Smith, November 30, 1888, Annual Report, Chief of Engineers for 1890, Part I, page 458, and the report of Colonel Damrell, January 30, 1897, that the obstructions to the navigation of the channel arise chiefly from slabs and other mill refuse which are deposited, in part, in the river above the head of navigation, to which section 6 of the river and harbor act of September 19, 1890, does not apply. As these deposits in the higher reaches probably receive year by year accumulations from the original sources, it is evident that improvements which may be made by dredging in the navigable sections below Ellsworth will be more or less subject to deterioration so long as the General Government fails to prevent it by adequate legislation. Additional legislation is therefore necessary to maintain any channels which may be improved.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers,
U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF MAJ. R. L. HOXIE, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Portland, Me., October 22, 1897.

GENERAL: In compliance with instructions from the Chief of Engineers, I have the honor to submit the following report upon survey of Union River, Maine, provided for by the river and harbor act of June 3, 1896:

The preliminary examination of this locality, with a view to its improvement, required by the same act, was made under the direction of my predecessor, Lieut. Col. A. N. Damrell, and report submitted January 30, 1897, which was published as House Doc. No. 6, Fifty-fifth

Congress, first session. I agree with Colonel Damrell in the opinion that the field work of additional surveys is unnecessary, the ground having been fully covered by a survey made in 1890, under the direction of Lieut. Col. Jared A. Smith, of which the maps and detailed estimates are now on file in this office, the report having been published in House Ex. Doc. No. 138, Fifty-first Congress, first session.

From these surveys it appears that the sum of $225,000 is required for a channel through the bar at the mouth of the river 100 feet in width and 6 feet deep at low tide, and through the narrows below Ellsworth, increasing to 150 feet in width in front of the wharves at Ellsworth. The estimate includes the construction of a jetty and training wall, the latter to be marked with three rough stone beacons, built to the height of 6 feet above mean high water, to preserve the channel over the bar after the dredging is completed. This project having been presented to Congress prior to the recent appropriation of $15,000 in the river and harbor act of June 3, 1896, must be considered the approved project for the improvement of Union River, although the appropriation of $15,000 is to be expended in dredging under the terms of the act. The contraction works at the mouth of the river will probably maintain the channel at that point, but the annual cost of maintenance of the channel through the narrows and in front of Ellsworth can not yet be estimated.

For the economical prosecution of this work it is necessary that a sufficient appropriation should be made to justify the employment of a suitable plant for doing the work expeditiously and economically. In this connection it is proper to invite attention to the necessity for further legislation to prevent the deposit of mill waste and other refuse in rivers. The improvement of all rivers upon the coast of Maine is more or less interfered with by the practice of throwing mill refuse into them; and while there has been a change for the better in this respect, the practice continues, sawdust and other waste being thrown in above the limit of navigation and finding its way into the navigable channel.

Very respectfully, your obedient servant,

R. L. HOXIE,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.
(Through the Division Engineer.)

[First indorsement.]

NORTHEAST DIVISION ENGINEER OFFICE,
New York, October 28, 1897.

Respectfully forwarded to the Chief of Engineers.

It appears from the report of Colonel Smith, November 30, 1888, Annual Report of the Chief of Engineers for 1890, Part I, page 458, and the report of Colonel Damrell, January 30, 1897, that the obstructions to the navigation of the channel arise chiefly from slabs and other mill refuse which are deposited, in part, in the river above the head of navigation, to which section 6 of the river and harbor act of September 19, 1890, does not apply. As those deposits in the higher reaches probably receive year by year accumulations from the original sources, it is evident that improvements which may be made by dredging in the navigable sections below Ellsworth will be more or less subject to deterio-

ration so long as the General Government fails to prevent it by adequate legislation. Additional legislation is therefore necessary to maintain any channels which may be improved.

* * * * * * *

G. L. GILLESPIE,
Colonel, Corps of Engineers, Division Engineer.

A 20.

SURVEY OF BAGADUCE RIVER, LEADING UP TO PENOBSCOT VILLAGE, MAINE.

[Printed in House Doc. No. 144, Fifty-fifth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 6, 1897.

SIR: I have the honor to submit the accompanying report of November 23, 1897, with map* by Maj. R. L. Hoxie, Corps of Engineers, of the results of a survey of Bagaduce River, Maine, leading up to Penobscot village, made to comply with requirements of the river and harbor act of June 3, 1896.

Penobscot village and South Penobscot constitute the town of Penobscot, situate on the Northern Bay branch of Bagaduce River, and a project for improvement of this locality by securing a channel 100 feet wide and 6 feet deep at mean low water from Bridges Point to Bowden's wharf, South Penobscot, adopted in 1890, is now being carried out by the United States. The cost of completing this project is now estimated to be $52,187.30; and an improvement which would reach Penobscot village would necessitate a duplicate dredged channel 2,600 feet in length, extending from deep water across intervening mud flats to the wharf, at a cost estimated by Major Hoxie to be $4[illegible],700.

In his letter transmitting this report Major Hoxie states that, in his opinion, the interests of commerce involved will not justify the proposed improvement under present conditions; that the existing project provides for a suitable improvement for this locality, and that any further expenditure for an additional channel to another point in the same town is not justifiable. His views are concurred in by the division engineer, Col. G. L. Gillespie, Corps of Engineers.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF MAJ. R. L. HOXIE, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Portland, Me., November 23, 1897.

GENERAL: In compliance with Department letter dated September 5, 1896, I have the honor to submit the following report of survey of

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* Not reprinted. Printed in House Doc. No. 144, Fifty-fifth Congress, second session.

"Bagaduce River, Maine, leading up to Penobscot village," provided for by the river and harbor act of June 3, 1896.

A preliminary examination of the Bagaduce River, under the river and harbor act of August 5, 1886, was made during that year, and a survey followed in 1888. This examination and survey furnished the greater part of the information now required under the act of June 3, 1896, and it has only been necessary to supplement them with a survey for a channel from the head of navigation of the North Fork of the Bagaduce River, in Northern Bay, to Penobscot village, on the shores of the bay. From these sources of information the following is compiled:

The Bagaduce River is a tidal water opening into Penobscot Bay at Castine. The lower part of the river forms the harbor of Castine, where the mean rise of the tide is 9.3 feet.

About 5 miles above the mouth of the river are the Narrows. The banks are at least 700 feet apart and the channel for the largest vessels is more than half that width.

Immediately above the Narrows the river is much broader and divides into the North and South forks. The tidal portion of the North Fork terminates in the Northern Bay.

From the Narrows to Penobscot the North Fork is broad and has a good channel, though somewhat indirect, as far as Bridges Point. This point is on the east shore, where the river widens into Northern Bay, about 3 miles from the Narrows, and a little more than three-fourths of a mile below the head of the channel at Penobscot.

The town comprises two villages, known, respectively, as Penobscot and South Penobscot. The latter is at the head of the tidal channel of the river on the southeast shore of the bay, while the former is 1 mile farther north.

Above Bridges Point, in the Northern Bay, the channel is narrow, and at low water has not sufficient depth for even the smaller coasting vessels which carry freights to distant points. Even this small channel is greatly obstructed by points of ledge and by bowlders where it passes between Winslows Island and the mainland.

The ledge and bowlders mentioned form such an obstruction that vessels are compelled to leave the channel entirely and pass over the flats on the other side of the island; this can only be done at high water and with vessels of comparatively small draft. Any regular or reliable communication by water is, therefore, at present impracticable, though the shipments by water from this point are sufficient to make freights for 210 vessels, many of them so large that they have to be loaded below Bridges Point, at great additional expense. In 1888 careful inquiry was made into the actual and prospective commerce of Penobscot, with the result that Major Smith reported as follows:

There is an extensive industry of brickmaking carried on in Penobscot, which is only awaiting better communication to be very largely increased. A large part of the bricks have to be lightered, and it is difficult to obtain the larger class of vessels for freight, so that the expense is increased about 50 cents per thousand for freight, lighterage, breakage, and delay.

The 50 cents per thousand thus lost represents a large part of the entire profit, so that the production is restricted. About 5,000,000 bricks is the present annual average of manufacture on the North Fork, and a good channel would probably result in doubling that number.

About 2,000 cords of wood are shipped from Penobscot annually; also, about 3,000 bushels of potatoes, and various other agricultural products.

Winstons Creek, which flows into the Northern Bay at South Penobscot village, furnishes power for two stave mills, two shingle mills, one sawmill and lath mill, and one mill for grinding corn meal. There is also in the village a knitting factory.

All these industries would be enabled to ship their products at reduced prices were the freights by water regular and reliable.

The number of freighting vessels arriving on the North Fork of the Bagaduce annually is given as 210, and about an equal number of yachts and small craft in addition.

There is a fine granite quarry which can not now be operated, owing to cost of transporting stone, which may figure among the prospective business of the place.

Penobscot is the natural outlet of quite a large section of country remote from any direct line of railroad, 10 miles over a hilly road from Castine Harbor, and 14 miles to the nearest point of the branch railroad from Bangor to Bucksport.

A regular line of steamers from points on Penobscot Bay is only awaiting a time when the channel above Bridges Point shall be improved to make daily trips to South Penobscot village.

Pursuant to the examination and survey of 1886 and 1888, the project for the improvement of the Bagaduce River was adopted, which contemplated the excavation of a channel 4,000 feet long, 100 feet wide, and 6 feet deep at low tide from Bridges Point to Bowden's wharf, South Penobscot, in Northern Bay, the object of the improvement being to enable boats drawing 6 feet of water to reach Bowden's wharf at low tide. The estimated cost of this improvement was $45,000, and there have been five separate appropriations, aggregating $22,000, of which $21,703.43 has been expended in the prosecution of the work.

Coast Survey chart No. 104 of Penobscot Bay, Maine, locates Penobscot at the head of the low-water channel which is now under improvement, but local nomenclature makes this South Penobscot and the village about 1 mile farther north is called Penobscot village. The two villages constitute the town of Penobscot. Deep water of the Bagaduce River extends about 1,600 feet beyond the entrance of the present dredged channel in the direction of Penobscot village, but terminates abruptly in the mud flats about 2,600 feet from the wharf. An improvement which would reach Penobscot village would necessitate a duplicate dredged channel, 2,600 feet in length, extending across these flats where no low-water channel now exists. The cost of completing work under the present project for improving the low-water channel to South Penobscot has been increased by insufficient appropriations and the development of more bowlder excavation than was anticipated. It is now estimated as follows, assuming adequate appropriations:

Dredging 43,500 cubic yards of clay, at 25 cents per yard	$10,875.00
Removing 4,899 tons of bowlders, at $7 per ton	34,293.00
Redredging 6,500 cubic yards clay, at 35 cents per yard	2,275.00
Engineering, supervision, and contingencies, 10 per cent	4,744.30
Total	52,187.30

In estimating the cost of a channel from deep water in the Bagaduce River to Penobscot village the same dimensions of channel are assumed, 100 feet in width and 6 feet in depth, and in the absence of sufficient information by multiplied borings on the line of this channel the proportion of bowlder excavation is predicated upon the work done in the channel to South Penobscot, up to but not including the rocky reef at Winslows Island. The shores of the bay present the same appearance at both localities, being covered with large bowlders, which also project at low tide from the mud flats in the vicinity of either channel, but the flats in the direction of North Penobscot are covered with a greater depth of clay. It is possible that in this way the proportion of bowlders in the channel leading up to Penobscot village is overestimated, but scattered borings can not be relied upon to give any indication

whatever of the proportion of bowlders present. The estimate is as follows, assuming adequate appropriations:

107,000 cubic yards clay and mud, at 25 cents	$26,750
2,100 tons bowlders, at $7 per ton	14,700
Engineering, superintendence, and contingencies	4,250
Total	45,700

The channel to South Penobscot, already dredged 40 feet wide, has silted up to some extent, probably on account of the fall of the side slopes into the excavation. The maintenance of the channel after completion to full width may require a small annual appropriation, but it follows the line of the existing low-water channel, which is also the outlet for Winstons Creek, so that it is evident that the tidal currents of the bay and the flow of Winstons Creek will combine to keep this channel clear. The channel to Penobscot village would not follow any indicated natural line of tidal current, and would probably silt up more rapidly. The annual cost of maintenance can not now be estimated.

A tracing, showing results of three surveys of Northern Bay and the compilation from Coast Survey chart No. 311, is transmitted herewith, and upon this is shown the present condition of the channel now under improvement and the location which will probably be the most favorable for the proposed channel to Penobscot village.

Very respectfully, your obedient servant,

R. L. HOXIE,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

APPENDIX B.

IMPROVEMENT OF RIVERS AND HARBORS IN EASTERN MASSACHUSETTS.

REPORT OF COL. S. M. MANSFIELD, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1898, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Newburyport Harbor, Massachusetts.
2. Merrimac River, Massachusetts.
3. Powow River, Massachusetts.
4. Essex River, Massachusetts.
5. Harbor of Refuge, Sandy Bay, Cape Ann, Massachusetts.
6. Gloucester Harbor, Massachusetts.
7. Manchester Harbor, Massachusetts.
8. Lynn Harbor, Massachusetts.
9. Mystic and Malden rivers, Massachusetts.
10. Boston Harbor, Massachusetts.
11. Town River, Massachusetts.
12. Weymouth River, Massachusetts.
13. Scituate Harbor, Massachusetts.
14. Plymouth Harbor, Massachusetts.
15. Provincetown Harbor, Massachusetts.
16. Chatham Harbor, Massachusetts.
17. Removing sunken vessels or craft obstructing or endangering navigation.

SURVEYS.

18. Merrimac River, Massachusetts.
19. Boston Harbor, Massachusetts.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., August 3, 1898.

GENERAL: I have the honor to transmit herewith annual reports for the works of river and harbor improvements in my charge for the fiscal year ending June 30, 1898.

* * * * * * *

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Colonel, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

B 1.

IMPROVEMENT OF NEWBURYPORT HARBOR, MASSACHUSETTS.

Newburyport, Mass., is situated about 2½ miles from the Atlantic Ocean, on the south bank of the Merrimac River.

The river empties into the Atlantic Ocean midway between Cape Ann and Portsmouth, or about 30 miles a little east of north from Boston in a direct line.

The outlet of the river between Plum Island and Salisbury Point is 1,000 feet wide and 30 feet deep at mean low water. At a distance of nearly a mile outside lies a sandy bar, thrown up by wave action, through which, previous to the improvement, a channel, variable in

position and depth, was maintained by the current of the river, increased by the tidal flow in a large interior basin, through a mean range of tides of 7.7 feet.

For 1,000 feet outward from the gorge toward the crest of the bar the current was able to maintain a channel of navigable width and 18 feet deep at mean low water, and for a farther distance of 1,500 feet a channel 12 feet deep. From the 18-foot contour line on the inside to the same on the outside the distance was 4,000 feet, and between the 12-foot contours the distance was 3,000 feet.

The depth on the crest of the bar was generally less than 7 feet at mean low water.

The object of the improvement is to create through the outer bar a channel 1,000 feet wide and at least 17 feet deep at mean low water, so that vessels may cross the bar and find a harbor at any stage of the tide with as great draft as can reach Newburyport by the river at high tide.

The project submitted September 18, 1880, proposed two converging rubblestone jetties and the protection of the beach in their vicinity.

The converging portion of the north jetty was to be about 2,900 feet long; of the south jetty, about 1,500 feet.

The outer ends of the jetties were to be about 1,000 feet apart, and to be extended parallel to the axis of the channel if found necessary.

The estimated cost for this project for shore protection and the converging portions of the jetties was $240,000.

The estimate was increased in 1881 to $365,000.

The project was modified in 1882 so as to provide for the partial closing of Plum Island Basin with a timber dike about 800 feet long and 5½ feet above mean low water. The location and details of construction of the dike are given in the report of 1883.

The direction of the south jetty and the character of the shore protection was modified in 1883.

In 1897 the estimate of cost of the jetties was revised and increased by $224,547.49, to provide for the construction of the parallel portions. (Annual Report, 1897, p. 825.)

Both jetties are 15 feet wide on top, which is in a plane 12 feet above mean low water, and have slopes of 1 on 2 on the sea side and 1 on 1 on the shore side.

A map showing the location of the jetties is published in the Annual Report of the Chief of Engineers for 1885.

The total appropriations to date have been $313,500.

The expenditures to June 30, 1897, were $295,984.69.

On June 30, 1897, the condition of the improvement was as follows:

The north jetty was 2,705 feet long, fully completed; the south jetty was completed for 1,540 feet, and its shore end was strengthened by a sand catch; the dike was completed so far as was prudent for its safety; it was 817 feet long, 5½ feet high above mean low water, except that near its center a weir had been left open, 150 feet long, its sill 2 feet above mean low water.

On October 12, 1896, a contract was entered into with the Rockport, Pigeon Hill, and Cape Ann granite companies to deposit 13,000 tons of stone in the south jetty, at $1.03 per ton.

Operations were in progress under this contract on June 30, 1897, and were continued during the fiscal year. 12,528 tons of rubblestone were deposited during the fiscal year, a total of 13,002 deposited under the contract, and it was satisfactorily completed on December 30, 1897.

The south jetty was extended 250 feet in length under this contract, making its total length 1,790 feet.

On May 27, 1898, it was recommended that a spindle be placed at the outer end of the completed section of the north jetty to serve as an aid to navigation. This recommendation was approved May 31, 1898, and on June 14, 1898, bids for erecting the spindle were asked for by circular letter to be opened on June 27, 1898.

On that date bids were received, and on June 27, 1898, the work was awarded to Pigeon Hill Granite Company, the lowest bidder.

At the date of this report the north jetty and the dike are in the same condition as on June 30, 1897.

No survey of the bar was made in 1898, but the reports of local pilots show that the extension of the south jetty has resulted as was anticipated in my report for 1897. The southern channel along the shore of Plum Island has been closed, and the eastward channel has been greatly improved by the scour of the deflected ebb currents.

The advantage to be derived from the completion of the project is the deepening and widening of the channel across the bar, thereby affording a harbor of refuge on the inside of Salisbury Beach and giving easy access at high tide to the wharves at Newburyport for vessels drawing 17 feet, approximately.

This work is located in the collection district of Newburyport, Mass., of which Newburyport is the port of entry. The nearest light-house is on Plum Island, at entrance of the harbor.

Money statement.

July 1, 1897, balance unexpended	$16,543.65
June 30, 1898, amount expended during fiscal year	14,793.42
July 1, 1898, balance unexpended	1,750.23
Amount (estimated) required for completion of existing project	286,047.49
Amount that can be profitably expended in fiscal year ending June 30, 1900	286,047.49
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

The dates and amounts of appropriations for this work are as follows:

Act of—		Act of—	
June 14, 1880	$50,000	September 19, 1890	$25,000
March 3, 1881	40,000	July 13, 1892	20,000
August 2, 1882	40,000	August 18, 1894	20,000
July 5, 1884	40,000	June 3, 1896	16,000
August 5, 1886	37,500		
August 11, 1888	25,000	Total	313,500

Abstract of proposals for furnishing rubblestone in the south jetty at Newburyport Harbor, Massachusetts, opened September 26, 1896, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price per ton of 2,000 pounds.	Total tons.
1	John L. Grim, Philadelphia, Pa	$1.24	12,903
2	Rockport Granite Co., Rockport, Mass Pigeon Hill Granite Co., Rockport, Mass. *a* Cape Ann Granite Co., Boston, Mass	1.03	15,533
3	George Willett Andrews, Biddeford, Me	1.21	13,223
4	Lanesville Granite Co., Lanesville, Mass	1.24½	12,851

a Lowest bidder.

The contract was awarded to the Rockport, Pigeon Hill, and Cape Ann Granite companies, with the approval of the Chief of Engineers.

The accompanying commercial statistics have been furnished by the collector of customs of Newburyport, Mass.

B 2.

IMPROVEMENT OF MERRIMAC RIVER, MASSACHUSETTS.

The mouth of the Merrimac River is 15 miles northwest from Cape Ann, Massachusetts. Tide water extends up it a distance of 21½ miles, or to the foot of the Upper Falls, 1½ miles above Haverhill, Mass.

Seven incorporated cities and the largest mills in New England are directly interested in this improvement.

Before improvement the channel was narrow and crooked and much obstructed by ledges, bowlders, and shoals.

At mean low water vessels drawing not to exceed 7 feet could enter the river and proceed to South Amesbury, 9 miles from the mouth. The sea bar at the mouth of the river has been improved under specific appropriations for the improvement of Newburyport Harbor, while many sunken rocks and wrecks of piers and vessels lying inside the bar have been removed by general appropriations for the improvement of the river.

The object of the improvement is to widen, straighten, and deepen the natural channel of the river from the bar to the head of tide water. The rise or fall of the tide at the mouth is 7.7 feet; at Haverhill Bridge, 4.62 feet.

The project originally adopted, in 1870, proposed to remove obstructions from the Upper and Lower Mitchells falls, and to remove the Gangway Rock and the Boilers in Newburyport Harbor.

The cost was estimated to be $69,025.

The project was modified in 1874 so as to include the removal of rocks in and near the draw of the bridge at Deer Island, 2 miles above Newburyport, and at Rock Bridge and at Little Currier Shoals, East Haverhill, so that the channel should have the following depths at ordinary high-water stages of the river: From the mouth to Deer Island Bridge, 5 miles, 16½ feet: thence to Haverhill Bridge, 12½ miles, 12 feet; thence to the foot of Mitchells Falls, Hazeltine Rapids, 1½ miles, 10 feet; thence through Mitchells Falls to the head of the Upper Fall, 2½ miles, not less than 4½ feet when the mill water at Lawrence is running.

This revised project was estimated to cost $147,000.

The total appropriations to date are $247,366.72.

The expenditures to June 30, 1897, were $246,060.67.

The excess of expenditure over the estimate is due to the removal of rocks and other obstructions that were unknown, and cost of removal not included in the estimate, and by the expense of necessary surveys and examinations not provided for in the estimate.

On June 30, 1894, the project for the improvement of the river was completed.

The river and harbor act of June 3, 1896, appropriated $5,000 for the removal of "certain rocks below Rock Bridge."

In November and December, 1896, 855 cubic yards of bowlders were dredged from the channel below Rock Bridge.

During the fiscal year the improvement of the channel at this point was continued, and 205 tons of bowlders were removed by a diving party employed by the day. At the date of this report the channel at this point has been cleared of the obstructing bowlders.

No other operations were in progress during the fiscal year.

This work is located in the collection district of Newburyport, Mass., of which Newburyport is the nearest port of entry. The nearest light-houses are the Plum Island lights and the Newburyport Upper Harbor lights.

No increase of the tonnage of the river is apparent since the improvement was commenced, and no new lines of water transportation have been established.

Money statement.

July 1, 1897, balance unexpended	$1,306.05
June 30, 1898, amount expended during fiscal year	1,160.00
July 1, 1898, balance unexpended	146.05

The dates and amounts of appropriations for this work are as follows:

Act of—		Act of—	
May 23, 1828	$32,100.00	June 18, 1878	$10,000.00
April 2, 1830	3,506.72	March 3, 1879	5,000.00
March 2, 1831	16,000.00	June 14, 1880	12,000.00
March 2, 1833	4,900.00	March 3, 1881	9,000.00
June 28, 1834	3,860.00	August 2, 1882	9,000.00
July 11, 1870	25,000.00	July 5, 1884	3,500.00
March 3, 1871	25,000.00	September 19, 1890	10,000.00
June 10, 1872	25,000.00	July 13, 1892	1,500.00
March 3, 1873	25,000.00	June 3, 1896	5,000.00
June 23, 1874	10,000.00		
March 3, 1875	12,000.00	Total	247,366.72

Appropriations made since 1870 have been expended on the approved project of that date and its modifications.

Commercial statistics are included in statement for Newburyport Harbor.

B 3.

IMPROVEMENT OF POWOW RIVER, MASSACHUSETTS.

Powow River is a tributary of the Merrimac River, into which it enters from the north about 3½ miles above Newburyport.

From its mouth tide water extends 9,600 feet in a narrow, crooked channel, not navigable at low water.

The mean rise or fall of tide is 6.7 feet.

The plan for improvement, submitted January 24, 1885, proposed to dredge a channel 9,600 feet long, 60 feet wide, and 12 feet deep at mean high water, at an estimated cost of $77,000.

The estimate was revised on March 24, 1897, and increased to $100,000. (Annual Report, 1897, p. 829.)

The total appropriations to date have been $39,000.

The expenditures to June 30, 1897, were $38,876.07.

At that date the improved channel was 12 feet deep at mean high water; 45 feet wide for a length of 3,252 feet from its upper end, and at least 30 feet wide throughout its entire projected length.

No operations have been in progress during the fiscal year, and at the date of this report the condition of the improvement is the same as on June 30, 1897.

To complete the improvement will require an appropriation of $61,000, all of which could be expended to advantage during the year ending June 30, 1899.

This work is located in the collection district of Newburyport, Mass., of which Newburyport is the nearest port of entry. The nearest light-houses are the Newburyport Upper Harbor lights.

No new lines of water transportation have been established.

Money statement.

July 1, 1897, balance unexpended	$123.93
June 30, 1898, amount expended during fiscal year	106.25
July 1, 1898, balance unexpended	17.68
Amount (estimated) required for completion of existing project	61,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	61,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

The total appropriations for this work are as follows:

Act of—		Act of—	
August 11, 1888	$3,000	June 3, 1896	$12,000
September 19, 1890	5,000		
July 13, 1892	4,000	Total	39,000
August 18, 1894	15,000		

No contracts are in force at date of this report.
Commercial statistics are included in the statement for Newburyport Harbor.

B 4.

IMPROVEMENT OF ESSEX RIVER, MASSACHUSETTS.

Essex River winds between marshy banks for 3½ miles from the head of navigation, at the village of Essex, to its mouth, which forms a harbor of refuge for light-draft vessels, about 3 miles to the southeastward of the entrance to Ipswich River, Massachusetts. The channel of the river is crooked and obstructed by sand bars and bowlders.

The project for its improvement was submitted May 15, 1891. It proposed to widen and deepen the upper 12,000 feet of the natural channel of the river, so that 4 feet at mean low water could be carried to the head of navigation in a channel 60 feet wide, at a cost, as estimated, of $25,000.

The mean rise or fall of the tide is 8.8 feet.

The total appropriations to date have been $15,000.

The expenditures to June 30, 1897, were $9,711.39.

At that date the channel had been dredged to its full projected depth, and at least 25 feet wide to the drawbridge in Essex. On July 13, 1897, a contract was entered into with the Eastern Dredging Company to dredge 14,000 cubic yards from the channel in continuation of the improvement.

Operations under this contract were commenced on October 14, 1897, and it was satisfactorily completed on December 22, 1897; 13,504¼ cubic yards of material were dredged under the contract, and at the date of this report the channel is 4 feet deep at mean low water, 60 feet wide for a distance of 4,000 feet below the drawbridge in Essex, and at least 25 feet wide for the remainder of the distance to its lower end.

No other operations have been in progress during the fiscal year.

To complete the improvement will require an appropriation of $10,000, all of which could be expended to advantage during the fiscal year ending June 30, 1899.

Essex River is in the collection district of Gloucester, Mass., of which Gloucester is the port of entry. The nearest light-house is Annisquam light, 2 miles east of the mouth of the river.

Money statement.

July 1, 1897, balance unexpended	$5,288.61
June 30, 1898, amount expended during fiscal year	5,012.39
July 1, 1898, balance unexpended	276.22
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

Appropriations have been made for this work, as follows:

Act of—	
July 13, 1892	$5,000
August 18, 1894	5,000
June 3, 1896	5,000
Total	15,000

Abstract of proposals for dredging in Essex River, Massachusetts, opened June 28, 1897, by Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price per cubic yard.		Total yards that can be dredged.
		For dredging.	For removal of bowlders over 6 tons each.	
1	Eastern Dredging Co., Boston, Mass. *a*	$0.31	$10	14,516
2	Augustus B. Martin, Boston, Mass.	.31½	8	14,285

a Lowest bid.

The contract was awarded to the Eastern Dredging Company, with the approval of the Chief of Engineers.

Commercial statistics are included in the statement for Gloucester Harbor, Massachusetts.

B 5.

HARBOR OF REFUGE, SANDY BAY, CAPE ANN, MASSACHUSETTS.

Sandy Bay is situated at the northeastern extremity of the promontory of Cape Ann, which forms the northern limit of Massachusetts Bay. Its shore lines form a little less than a right angle, and their directions are nearly north and south and east and west. The rocky island of Straitsmouth forms the eastern extremity of one shore line, and the steep headland of Andrews Point the northern end of the other. Following the line of the proposed breakwater, the bay is 2¾ miles wide by 2 miles in area, approximately.

The bay on the land side is perfectly protected by steep, high hills, but it fronts the northeast and is open to the full force of the violent northerly and easterly gales of this coast.

The great seas of the ocean are broken, however, in a degree by the sunken rocky ledges called Averys Ledge, the Dry and Little Salvages, the Flat Ground, and Abners Ledge, which are directly at the mouth of

the bay. Inside these entrance ledges the bay is entirely unobstructed and has an average depth of 50 feet at mean low water.

The original project for improvement was submitted in 1884. It proposed a continuous breakwater 9,000 feet long, divided into two branches. One starts at Averys Ledge and runs in a direction a little west of north to Abners Ledge, a distance of 3,600 feet; the other extends 5,420 feet from Abners Ledge in a northwesterly direction, and terminates at the 84-foot contour off Andrews Point.

The substructure was to consist of a mound of rubblestone to a grade of 22 feet below mean low water, 40 feet wide on top, to be surmounted by a masonry wall.

The axis of the proposed breakwater is approximately at the inner edge of the ledges, at the entrance of the bay, and about 1 mile inside the Salvages and Flat Ground, which receive the first shock of easterly storm waves.

The southern entrance to the proposed harbor lies between Straitsmouth Island and Averys Ledge, and is to be 1,800 feet wide and at least 30 feet deep. The northern entrance, near Andrews Point, is 2,700 feet wide and 80 feet deep. They are so located with reference to each other that vessels can enter and leave the harbor with any wind.

The harbor formed by the breakwater covers an anchorage of 1,377 acres, in which the depth exceeds 24 feet at mean low water.

On March 2, 1892, the project was modified by a report of the special board of engineers constituted for that purpose, and proposes to construct the entire breakwater of rubblestone, with the following section: On the seaside, from the bottom to 15 feet below mean low water, a slope of 1 on 1½; thence to mean low water, 1 on 3; thence to mean low water, 1 on 1; the width on the crest 20 feet, and the rear slope 1 on 0.73, to mean low water; thence to the bottom, 1 on 1.

A plan of the bay showing the proposed breakwater was published in the Annual Report of the Chief of Engineers for 1892, page 564.

The estimated cost of the improvement is $5,000,000, to which must be added $2,500,000 for buoyage, lighting, and defense of the harbor.

The total appropriations to date have been $900,000.

The expenditures to June 30, 1897, were $723,485.25.

At that date 600 feet of the breakwater were completed, 1,200 feet additional were completed of full section up to low water, and 2,800 feet more were built up to 22 feet below low water, 40 feet wide on top.

Nine hundred and twenty-three thousand three hundred and thirty-two tons of small stone and 13,488 tons of large stone had been deposited in the breakwater in this construction, and operations were in progress under two contracts—one with the Cape Ann Granite Company to deposit 240,000 tons, and one with the Rockport and Pigeon Hill and the Cape Ann granite companies to deposit 200,000 tons of stone in the substructure of the breakwater.

These operations were continued during the fiscal year. 32,457 tons of stone were deposited during the year under the first-mentioned contract with the Cape Ann Granite Company, making a total of 240,600 tons deposited under the contract, which was satisfactorily completed on September 29, 1897. 108,488 tons of stone were deposited under the second contract during the year, a total of 140,155 tons under that contract.

About February 1, 1898, a storm of extraordinary severity visited this coast, resulting in great loss of life and vessel property. In the small harbors at Sandy Bay five vessels were totally destroyed and a number more were badly damaged. This storm was of several days' duration, and at its height blew from the northeast. The completed por-

tion of the breakwater was damaged by this storm, nearly the entire length of 600 feet being torn down to the level of high water. No appreciable damage was done to the remainder of the work.

A total of 1,064,277 tons of small stone and 13,488 tons of large stone have been deposited in the breakwater to date, and its condition is as follows: 600 running feet are completed up to high water, 2,400 feet additional are practically completed to low water, and for a further length of 1,600 feet the mound is at least 40 feet wide on top and up to 22 feet below low water.

To complete the project will cost $4,100,000.

During the fiscal year ending June 30, 1900, $500,000 could be expended to advantage.

The prospective benefits to commerce and navigation by the construction of this harbor of refuge are increased safety to life and property and a consequent reduction in freight and insurance.

Sandy Bay is situated in the collection district of Gloucester, Mass., of which Gloucester is the port of entry. The nearest light-house is Straitsmouth Light, at the southern entrance of the bay.

Money statement.

July 1, 1897, balance unexpended		$176,514.75
June 30, 1898, amount expended during fiscal year		103,822.29
July 1, 1898, balance unexpended		72,692.46
July 1, 1898, outstanding liabilities	$18,849.04	
July 1, 1898, amount covered by uncompleted contracts	40,036.32	
		58,885.36
July 1, 1898, balance available		13,807.10
Amount (estimated) required for completion of existing project		4,100,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900		500,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

The dates and amounts of the appropriations for this work are as follows:

Act of—		Act of—	
July 5, 1884	$100,000	August 18, 1894	$150,000
August 5, 1886	100,000	June 3, 1896	150,000
August 11, 1888	100,000	Total	900,000
September 19, 1890	150,000		
July 13, 1892	150,000		

Abstract of proposals for furnishing rubblestone in the breakwater at Sandy Bay, Massachusetts, opened October 4, 1894, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid per ton of 2,000 pounds.	Total tons can be delivered.
		Cents.	
1	Cape Ann Granite Co., Boston, Mass. *a*	59.7	251,256
2	Pigeon Hill Granite Co., Rockport, Mass	69	217,391
3	George Willett Andrews, Biddeford, Me	81	185,185
4	Hughes Bros. & Bangs, Syracuse, N. Y	77	194,805
5	Rockport Granite Co., Rockport, Mass	61	245,901

a Lowest bid.

The contract was awarded to the Cape Ann Granite Company, with the approval of the Chief of Engineers.

Abstract of proposals for furnishing rubblestone in the breakwater at Sandy Bay, Massachusetts, opened September 26, 1896, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid per ton of 2,000 pounds.	Total tons.
		Cents.	
1	John L. Grim, Philadelphia, Pa	84.5	177,514
2	Rockport Granite Co., Rockport, Mass Pigeon Hill Granite Co., Rockport, Mass. *a* Cape Ann Granite Co., Boston, Mass	66.9	224,215
3	Lanesville Granite Co., Lanesville, Mass	81.2	184,729

a Lowest bid.

The contract was awarded to the Rockport, Pigeon Hill, and Cape Ann Granite companies, with the approval of the Chief of Engineers.

LIST OF CONTRACTS IN FORCE AT THE DATE OF THIS REPORT.

Contract dated October 12, 1896: Contractors, Rockport, Pigeon Hill, and Cape Ann Granite companies; to furnish 200,000 tons, more or less, of rubblestone in breakwater, at 66.9 cents per ton.

Date of approval, October 31, 1896; to be commenced November 12, 1896; to be completed December 31, 1898.

COMMERCIAL STATISTICS.

The accompanying commercial statistics for the fiscal year ending June 30, 1898, have been furnished by Mr. Charles S. Rogers, of Rockport, Mass.

Articles.		1896.	1897.	1898.
Shipped:				
Stone	tons	430,000	475,000	550,000
Fresh fish	pounds			3,000,000
Salt fish	do			615,000
Fish sounds	do			283,000
Mackerel	barrels			250
Lobsters	do			750
Herring	do			550
Cod oil	gallons			5,000
Medicine oil	do			5,500
Received:				
Coal	tons	8,500	10,400	10,000
Wood	cords	400	350	365
Lumber	feet	750,000	820,000	750,000
Salt	hogsheads	550	575	585
Fish	pounds	2,500,000	2,525,000	
Mackerel	barrels	500	275	
Fish sounds	pounds	276,000	279,000	
Lobsters	barrels	750	400	
Cod oil	gallons	3,000	4,500	
Medicine oil	do	4,000	5,000	
Herring	barrels	500	450	
Salt fish	pounds	600,000	608,000	

B 6.

IMPROVEMENT OF HARBOR AT GLOUCESTER, MASSACHUSETTS.

Gloucester Harbor is an important center for the fishing fleet of New England, about 20 miles north of Boston. Its inner harbor was originally obstructed by sunken rocks and shoals, and the approaches to

the wharves were shallow, varying from 1 to 12 feet. The outer harbor was open to all southerly gales.

The first project for its improvement was submitted January 20, 1871, and proposed to build a breakwater from Eastern Point to Round Rock Shoal and to clear the harbor of sunken rocks.

The present approved project was submitted in 1887. (Annual Report for 1887, Part I, p. 500.) It proposed to remove from the inner harbor obstructing rocks and shoals, giving in front of the wharves, as far as Pew's wharf, 15 feet depth at low water and 10 feet in Harbor Cove, and to build a breakwater from Eastern Point to Round Rock Shoal.

On May 5, 1897, a project was submitted for the removal of a pinnacle rock in the outer harbor to a least depth of 16 feet at mean low water and rocks off the ferry landing at Rocky Neck to the level of the surrounding bottom, at a cost of $2,000. (Annual Report, 1897, p. 835.)

On December 18, 1897, a revised project for the construction of the breakwater was submitted. This project proposed to build the substructure of the breakwater of rubblestone up to mean low water and 31 feet wide at that grade; to be surmounted by a superstructure formed of two dry walls of heavy split stone laid with the greatest dimension at right angles to the axis of the breakwater, the interior space to be filled with rubblestone, and to be capped by heavy stone, forming a top course 10 feet in width.

This project was estimated to cost $733,121.18, and was approved January 4, 1898.

The total appropriations to date have been $154,000.

The expenditures to June 30, 1897, were $134,385.68.

At that date all dredging under the project of 1887 had been completed, and the construction of the breakwater was in progress. 74,468 tons of rubblestone had been deposited in the breakwater, and 1,100 feet of the substructure had been completed to mean low water.

A contract was in force with the Rockport, the Pigeon Hill, and the Cape Ann granite companies, dated October 12, 1896, to deposit 34,000 tons of stone in the breakwater.

Operations were continued during the fiscal year under this contract, and it was satisfactorily completed April 5, 1898. 16,332 tons of stone was deposited after June 30, 1897, making a total of 34,000 tons deposited under the contract.

On July 6, 1897, a contract was entered into with Mr. Hiram W. Phillips for the removal of 105 cubic yards of ledge under the project of May 5, 1897.

Operations under this contract were closed on August 19, 1897, and the project completed.

No benefit has resulted from the construction of the breakwater, as no sheltered anchorage has as yet been obtained, but navigation in the harbor has been greatly facilitated by the dredging and ledge removal.

To complete the improvement will require an appropriation of $624,083.43, of which $200,000 could be expended to advantage during the fiscal year ending June 30, 1900.

The prospective advantage to commerce by the completion of the improvement is more safe anchorage for vessels seeking protection from southerly gales.

Gloucester Harbor is in the collection district of Gloucester, Mass., of which Gloucester is the port of entry. The nearest light-houses are Ten-Pound Light, in the harbor, and Eastern Point Light at its entrance.

Money statement.

July 1, 1897, balance unexpended	$19,614.32
June 30, 1898, amount expended during fiscal year	18,783.38
July 1, 1898, balance unexpended	830.94

Amount (estimated) required for completion of existing project	624,083.43
Amount that can be profitably expended in fiscal year ending June 30, 1900	200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

The dates and amounts of the appropriations for this work are as follows:

Act of—		Act of—	
June 10, 1872	$10,000	August 18, 1894	$40,000
August 5, 1886	5,000	June 3, 1896	34,000
August 11, 1888	10,000	Total	154,000
September 19, 1890	15,000		
July 13, 1892	40,000		

Abstract of proposals for furnishing rubblestone in breakwater at Gloucester, Mass., opened September 26, 1896, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price per ton of 2,000 pounds.	Total tons.
		Cents.	
1	John L. Grim, Philadelphia, Pa	92	34,782
a 2	Rockport Granite Co., Rockport, Mass Pigeon Hill Granite Co., Rockport, Mass Cape Ann Granite Co., Boston, Mass	83	38,554
3	Lanesville Granite Co., Lanesville, Mass	90	35,555

a Lowest bid.

The contract was awarded to the Rockport, Pigeon Hill, and Cape Ann granite companies, with the approval of the Chief of Engineers.

Abstract of proposals for the removal of ledges from Gloucester Harbor, Massachusetts, opened June 28, 1897, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price per cubic yard.	Total amount.
1	Cornelius Van Anglen, East Boston, Mass	$19.00	$1,995.00
2	John Olson George W. Townsend, Boston, Mass	15.93	1,672.65
a 3	Hiram W. Phillips, Quincy, Mass	15.85	1,664.25

a Lowest bid.

The contract was awarded to Hiram W. Phillips, with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

The accompanying commercial statistics have been furnished by the collector of customs at Gloucester, Mass.

Amount of revenue collected:

1896	$1,150
1897	8,000
1898	6,079

Shipping.	1896.		1897.		1898.	
	No.	Tons.	No.	Tons.	No.	Tons.
Entrances:						
Foreign	107	20,153	104	24,761	107	19,872
Domestic	7	947	10	14,400	28	4,000
Clearances:						
Foreign	101	17,120	102	25,400	103	10,563
Domestic	24	12,621	45	19,200	31	7,400

Articles.	1896.	1897.	1898.
Imported:	*Tons.*	*Tons.*	*Tons.*
Coal	49,900	47,000	60,000
Salt	24,000	25,000	22,000
Lumber	500	2,200	500
Merchandise	25,000	4,000	1,000
Miscellaneous	500	2,000	500
Exported:			
Coal	.....	200	.....
Salt	1,000	1,200	1,500
Merchandise	.....	1,000	550

All classes of vessels frequent the harbor. Greatest draft, 30 feet; number of vessels boarded by United States boarding officer, about 5,200.

B 7.

IMPROVEMENT OF HARBOR AT MANCHESTER, MASSACHUSETTS.

Manchester Harbor is situated about 5½ miles northeast from the entrance of Salem Harbor, Massachusetts.

The channel was 100 feet wide and 6½ feet deep at mean low water up to Proctors Point. It then shoaled rapidly to a depth of 1½ feet at "The Narrows," 1,400 feet from Proctors Point, and for a farther distance of 2,500 feet to the town wharves no low-water channel existed.

The project for its improvement, submitted November 28, 1887, proposed to dredge a channel from Proctors Point to the town wharves 60 feet wide and 4 feet deep at mean low water, at an estimated cost of $14,300.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for 1888, Part I, page 466.

The river and harbor act of June 3, 1896, provided that—

The Secretary of War is directed, out of the appropriation on hand, to cause a survey and estimate of cost of improvement to be made with a view of straightening the channel between the mouth of Manchester Harbor and Proctors Point, removing obstructions at the mouth of the channel and at the point of rocks, dredging the channel for its entire length between its mouth and the town wharf to a width of from two hundred feet, narrowing to one hundred and fifty feet, and a depth of eight feet, and providing turning basins and anchorage for boats by the dredging of the flats for that purpose.

The survey ordered by this act was made in August, 1896, and a project and an estimate of cost thereof in accordance with the act were submitted April 7, 1897.

This project was published as House Doc. No. 29, Fifty-fifth Congress, first session.

The estimated cost of the project was $139,966.09.

The total appropriations to date have been $14,300.

The expenditures to June 30, 1897, were $14,246.96, and at that date the improvement was completed. The channel was 60 feet wide, 4 feet deep, and 4,000 feet long; opposite the town wharf it was 80 feet wide.

During the fiscal year no operations in improvement of the harbor were in progress.

On July 30, 1897, in accordance with section 9 of the river and harbor act of June 3, 1896, and Department letter of June 30, 1897, a project for improvement of the harbor was submitted, which was considered to be justified by the interests of the commerce involved.

This project proposed to follow the natural channel and to dredge the same to a depth of 6 feet at mean low water for a length of 7,200 feet, and to make it 100 feet wide at the entrance and at the sharp bends, and at least 75 feet wide throughout, with two turning or anchorage basins, one 200 feet by 300 feet in area, just below the bridge, and the other 125 feet by 250 feet, near the town landing wharf, at an estimated cost of $25,000.

This project was published in the Annual Report for 1897, page 869.

The commerce involved in this improvement consists of supplies of coal, lumber, etc., for local consumption. The improvement in its present condition has greatly facilitated the approach of vessels to the town wharves.

The value of the commerce involved is approximately $30,000 annually.

Commercial statistics are included in the statement for Gloucester Harbor, Massachusetts.

Manchester Harbor is in the collection district of Gloucester, Mass., of which Gloucester is the port of entry. The nearest light-house is on Bakers Island, 2¼ miles from Proctors Point.

Money statement.

July 1, 1897, balance unexpended	$53.04
June 30, 1898, amount expended during fiscal year	53.04

The total appropriations for this improvement to date have been:

By the act of—	
August 11, 1888	$2,500
September 19, 1890	5,000
July 13, 1892	6,800
Total	14,300

B 8.

IMPROVEMENT OF HARBOR AT LYNN, MASSACHUSETTS.

Lynn Harbor is 9 miles northeast from Boston.

The original channels were narrow and crooked, and had but 6 feet depth at mean low water.

The project for improvement was adopted in 1884. It proposed a channel 200 feet wide, 10 feet deep at mean low water, through the

outer and inner bars. It is supposed that the inner channel will require occasional dredging, and a training wall was proposed, if required, to aid in keeping the outer channel open.

On September 24, 1888, it was proposed to extend the inner channel 400 feet within the harbor line and to excavate at its inner end an anchorage basin 500 by 300 feet in area, 10 feet deep at mean low water, at a cost of $25,000.

The estimated cost of the original project was $157,000; adding the cost of the extension of September 24, 1888, the estimated cost is $182,000.

The river and harbor act of June 3, 1896, ordered a survey of this harbor "with a view to securing a channel 300 feet wide and 15 feet deep at mean low water."

On March 27, 1897, a project was submitted in accordance with this act, the estimated cost of which was $441,813.17.

No appropriation has as yet been made for work under this project.

The total appropriations to date have been $128,500.

The total expenditures to June 30, 1897, were $103,650.05 on the project, and $5,000 on the western or Saugus River channel under act of June 13, 1892. At that date the outer channel and basin were completed; the inner channel was completed for 4,100 feet at its southerly end, and the remainder was 150 feet wide; the western or Saugus River channel was 4,000 feet long, 150 feet wide, 8 feet deep at mean low water.

The approach of vessels to the city wharves was greatly facilitated by the improvement.

A contract was in force with Mr. Augustus B. Martin to dredge 40,000 cubic yards, more or less, from the inner channel, at 21⅞ cents per cubic yard, scow measurement.

Operations under this contract were commenced on July 6, 1897, and completed August 25, 1897; 54,092 cubic yards were dredged under the contract and the inner main ship channel was completed of full projected length, width, and depth.

At the date of this report, the outer and inner main ship channels are 200 feet wide, 10 feet deep at mean low water, and the project of improvement is completed with the exception of the training wall.

To complete this improvement will require an appropriation of $53,500 for the construction of the training wall, but the necessity for this work is not yet apparent.

Lynn is a port of entry in the collection district of Marblehead, Mass. The nearest light-house is Egg Rock (Nahant) Light, 3 miles distant.

Money statement.

July 1, 1897, balance unexpended	$19,849.95
June 30, 1898, amount expended during fiscal year	12,444.15
July 1, 1898, balance unexpended	7,405.80

The dates and amounts of appropriations for this work are as follows:

Act of—		Act of—	
August 2, 1882	$60,000	August 18, 1894	$7,500
August 5, 1886	6,000	June 3, 1896	20,000
August 11, 1888	10,000	Total	128,500
September 19, 1890	15,000		
July 13, 1892	10,000		

Abstract of proposals for dredging in Lynn Harbor, Massachusetts, opened April 19, 1897, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid per cubic yard.		Total for dredging 40,000 cubic yards.
		For dredging.	Bowlders over 3 tons each.	
		Cents.		
1	Charles H. Souther, Boston, Mass	23	$8	$9,200
2	Eastern Dredging Co., Boston, Mass	24½	10	9,600
3	Augustus B. Martin, Boston, Mass. *a*	21⅞	8	8,750

a Lowest bid.

The contract was awarded to Augustus B. Martin, with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

The accompanying commercial statistics were furnished by the collector of customs at Marblehead, Mass.

Amount of revenue collected:

1896	$298.15
1897	77.83
1898	3,192.91

Shipping.	1896.		1897.		1898.	
	No.	Tons.	No.	Tons.	No.	Tons.
Entrances:						
Foreign	64	6,029	54	5,193	22	2,188
Domestic	329	121,000	561	177,265	737	182,271
Clearances:						
Foreign	67	6,238	52	5,044	24	2,395
Domestic	329	121,000	561	177,265	737	182,271

Imported.	1896.	1897.	1898.
	Tons.	*Tons.*	*Tons.*
Coal	158,480	140,900	145,523
Iron	974	2,089	.....
Lumber	*a* 7,995,525	*a* 6,320,781	*a* 2,616,000
Merchandise	*b* 500,000	*b* 85,000	*b* 90,000
Miscellaneous	*b* 475,000	*b* 50,000	*b* 60,000

a Feet. *b* Lime, hay, bricks, sand, cement, stone, etc.

Lumber imported includes both foreign and domestic.

All classes of vessels frequent the harbor, drawing from 8 to 18 feet of water.

B 9.

IMPROVEMENT OF MYSTIC AND MALDEN RIVERS, MASSACHUSETTS.

Mystic River empties into the inner harbor of Boston, Mass.

Malden River is tributary to the Mystic River, their junction being 3 miles above the mouth of the latter.

Originally no low-water channel existed in either river.

A project for the improvement of Mystic River was submitted May 9, 1891. It proposed to widen and deepen the natural channel to the head of navigation in Medford, a distance of about 4½ miles, so that it should be 100 feet wide, 6 feet deep at mean low water to the first turn above Denning's wharf, thence 4 feet deep at mean low water, the width gradually contracting to 50 feet at the upper end, estimated to cost $25,000.

The original project for the improvement of Malden River was submitted December 1, 1880. It contemplated the excavation of a channel 100 feet wide and 12 feet deep at mean high water up to the second drawbridge, with two cut-offs, one east of the island, near the junction of the Malden and Mystic rivers, and the other through the marsh land about half a mile above, at a cost of $35,000.

This project was modified in 1882. It was then proposed to make the natural channel 100 feet wide and 12 feet deep at mean high water to the first bridge, and thence 75 feet wide to the second bridge, at an estimated cost of $40,000. The mean rise or fall of tide is 9.8 feet.

The estimate was increased to $47,000 in 1884. (Annual Report, 1884, p. 551.)

Ten thousand dollars was appropriated for this work by the act of 1882, and expended (1883–84) in making the channel from the mouth to the drawbridge in Malden, a distance of 1¼ miles, at least 50 feet wide (70 feet at turns) and 12 feet deep at mean high water.

November 1, 1890, a project was submitted for the improvement of this river in conjunction with Mystic River. This project proposed the completion of the project of 1882 at an estimated cost of $37,000.

The total appropriations to date under present approved projects have been $30,000.

The expenditures to June 30, 1897, under the present projects were $20,117.08.

At that date the channel in Mystic River was 6 feet deep at mean low water and 100 feet wide to the first turn above Denning's wharf, and for 1,500 feet above this turn it was 4 feet deep and at least 50 feet wide. The channel in Malden River was at least 75 feet wide and 12 feet deep at mean high water to the first bridge, above which nothing had been done.

A contract was in force with Mr. Augustus B. Martin to dredge 26,000 cubic yards, more or less, at 34½ cents per cubic yard, from these rivers—13,000 cubic yards from each river.

Operations under this contract were commenced June 17, 1897, and were continued during the fiscal year; 13,222 cubic yards were dredged from Mystic River and 12,778 cubic yards from Malden River, and the contract was satisfactorily completed on December 4, 1897.

At the date of this report the channel in Mystic River is 6 feet deep at mean low water, and 100 feet wide to the first turn above Denning's wharf, and for a farther distance of 4,000 feet above this turn it is 4 feet deep and of full projected width. The channel in Malden River is of full projected depth and width up to the first bridge. Nothing has been done above this bridge.

To complete the improvement of Mystic River would require an appropriation of $10,000, and of Malden River $22,000, a total of $32,000, all of which could be expended to advantage during the fiscal year ending June 30, 1899.

Mystic and Malden rivers are in the collection district of Boston, Mass., of which Boston is the port of entry. The nearest light-house is on Long Island, Boston Harbor, Massachusetts.

Money statement.

July 1, 1897, balance unexpended	$9,882.92
June 30, 1898, amount expended during fiscal year	9,856.00
July 1, 1898, balance unexpended	26.92
Amount (estimated) required for completion of existing project	32,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	32,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

The dates and amounts of appropriations for this work are as follows:

For Malden River, by act of August 2, 1882	$10,000
For Mystic and Malden rivers, by act of July 13, 1892	10,000
For Mystic and Malden rivers, by act of August 18, 1894	10,000
For Mystic and Malden rivers, by act of June 3, 1896	10,000
Total	40,000

Abstract of proposals for dredging in Mystic and Malden rivers, Massachusetts, opened September 29, 1896, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price per cubic yard.		Total yards that can be dredged.
		For dredging.	Bowlders over 3 tons each.	
		Cents.		
1	Charles H. Souther, Boston, Mass	41	$10	24,390
2	Augustus B. Martin, Boston, Mass. *a*	34½	5	28,985
3	Eastern Dredging Co., Boston, Mass	36	5	26,315

a Lowest bid.

The contract was awarded to Augustus B. Martin, with the approval of the Chief of Engineers.

No contracts are in force at the date of this report.

B 10.

IMPROVEMENT OF HARBOR AT BOSTON, MASSACHUSETTS.

Boston Harbor consists essentially of an inner and an outer harbor, united by a deep waterway, and each accessible from the sea by a distinct channel, widening into a deep and spacious roadstead.

1. Inner harbor. This harbor lies to the north and westward of Long Island and has deep water and good anchorage in the President Roads, seaward of Lower Middle Bar, and also near the city westward of Upper Middle Bar.

Four rivers discharge their waters into the basin—the Charles, Mystic, and Chelsea rivers from the north and the Neponset from the south. The direct entrance from the sea is by Broad Sound.

2. Outer harbor. This harbor lies to the southward of Long Island and has a fine anchorage in Nantasket Roads, as well as in Hingham Bay, a well-sheltered harbor southeast of Peddocks Island. It connects with the inner harbor by the main channel through the Narrows,

and by secondary channels east and west of Long Island. It is reached from the sea from Nantasket Roads, which lie south of Georges and Great Brewster islands, and is marked at the sea entrance by Boston light.

Weymouth and Weir rivers empty into the outer harbor.

Both the inner and outer harbors are subdivided into several minor harbors and contain many islands, which shelter the anchorage from winds and storm waves.

The range of the tide at the navy-yard is 9.8 feet, and at the entrance to the outer harbor 9.4 feet. A sketch of the harbor was printed in the Annual Report of the Chief of Engineers for the year 1888, page 454.

The object of the improvement is, first, to preserve the harbor by protecting the islands and headlands; the second, to improve it by widening, deepening, and straightening the channels.

The works of preservation consist of sea walls, aprons, jetties, etc., which protect the shores of the islands and headlands, prevent additional wash into the channels, control the tidal scour, and preserve the full height of anchorage shelter for vessels in the roadsteads.

The works of improvement have been by dredging and blasting.

The total appropriations from 1825 to date have been $3,274,276.10.

The total expenditures to June 30, 1897 (not including outstanding liabilities), were $2,730,065.74.

WORKS OF PRESERVATION.

The location and details of these works are given in the Annual Report of the Chief of Engineers for 1895, pages 621 and 622.

With the exception of the sea walls at Deer Island, they were all in fair order on June 30, 1897, and no work has been done on them during the year. They are generally strongly built, massive structures, but in very exposed positions, and liable to damage by storms. These damages are most economically repaired when they first occur, and funds for this purpose should always be on hand.

On June 30, 1897, operations were in progress on the north and middle head sea walls at Deer Island, about 228 running feet of which required repairs, at an estimated cost of $2,500.

These operations were concluded in October, 1897.

With the exception of the south head wall at Deer Island, the sea walls are in fair order at the date of this report, but additional works of preservation are required as follows:

At Point Allerton.—The sea wall should be extended westward for a distance of at least 150 feet and the foundation of this extension should be protected with riprap, at an estimated cost of $15,000.

At Georges Island.—The unprotected western shore line of the island, in front of the Government buildings, has been considerably abraded, and it should be protected by a light sea wall, 1,400 feet long, at a cost of $35,000.

At Governors Island.—The shore line of this island has never been protected. The east and south bluffs, however, should be covered by sea walls to prevent additional abrasion, not only to secure the sites of the batteries which occupy these bluffs, but also to prevent injury to the main ship channel.

The east bluff wall should be 500 feet long, and is estimated to cost $30,000; the south bluff wall should be 1,800 feet long, and will cost $50,000.

WORKS OF IMPROVEMENT.

The main ship channel.—Before improvement it had a least width of 100 feet and a least depth of 18 feet at mean low water.

At the present time the main ship channel is being improved under a revised project submitted August 11, 1892. It proposes, in accordance with the act of July 13, 1892, to widen and deepen the channel so that it shall be 1,000 feet wide and 27 feet deep at mean low water. The revised project was estimated to cost $1,250,000.

The original project of improvement of the harbor was submitted in 1867. It proposed to dredge the channel 23 feet deep at mean low water, 1,000 feet wide at the Upper and Lower middles, and 685 feet at the Narrows.

In 1870 the proposed width of the channel at the Narrows was reduced to 625 feet and increased to 1,100 feet at the anchorage shoal in the inner harbor.

Under this project, to the time of the adoption of the project of 1892, the main ship channel had been made 23 feet deep at mean low water, 1,100 feet wide west of the Upper Middle, 850 feet wide at the Upper Middle, 1,000 feet wide at the Lower Middle, and at least 625 feet wide elsewhere.

A list of the positions where dredging and blasting were done in effecting this improvement will be found in the Annual Report of the Chief of Engineers for 1895, page 623.

To complete the project of 1867 the Upper Middle must be widened to 1,000 feet, which work is necessarily included in the project of 1892.

On June 30, 1897, under the project of 1892, the main channel had been dredged to make it 27 feet deep at mean low water, 1,000 feet wide from the entrance (near the outer light) to Bug Light, and in the Narrows 800 feet wide to the passage between Georges and Gallops islands, where it was at least 550 feet wide; but the free use of this 27-foot channel was restricted by reason of ledges uncovered by the dredging.

Operations were in progress under a contract with Messrs. Townsend & Johnston, of Somers Point, N. J., to remove these ledges, containing 8,722 cubic yards, at $16.48 per cubic yard, from the main channel, and the contract was satisfactorily completed on November 8, 1897, making available the full width of the channel which had been dredged to the 27 feet depth.

The total appropriations for this revised project of 1892 are:

By the act of—	
July 13, 1892	$265,000
August 18, 1894	190,000
June 3, 1896	45,000
Sundry civil act June 4, 1897	400,000
Total	900,000

The act of June 3, 1896, provided as follows:

Improving harbor at Boston, Massachusetts: Continuing improvement, seventy thousand dollars: *Provided,* That this sum may, in the discretion of the Secretary of War, be used in the preservation and improvement of said harbor, including the project for improving the main ship channel, and that seven thousand dollars of this sum may, in the discretion of the Secretary of War, be used in improving Chelsea Creek, and so much thereof as the Secretary of War, in his discretion, shall direct to be expended for the protection of Great Head, Winthrop, to prevent the further washing away by the action of the sea: *Provided,* That contracts may be entered into by the Secretary of War for such materials and work as may be necessary to carry out the revised project of August eleventh, eighteen hundred and ninety-two, such contracts to provide that said ship channel shall be widened to a minimum width of one thousand feet and a minimum depth of twenty-seven feet, to

be paid for as appropriations may from time to time be made by law, in the aggregate not to exceed one million one hundred and forty-five thousand dollars, exclusive of amount herein and heretofore appropriated.

On February 11, 1897, a contract was entered into with Messrs. Breymann Bros., of Toledo, Ohio, to dredge 2,910,718 cubic yards, more or less, from the main ship channel, in completion of the project of August 11, 1892.

Operations under this contract were commenced on October 25, 1897, and during the fiscal year 479,308½ cubic yards of material were dredged from the lower main ship channel in the Narrows.

At the date of this report the main ship channel is 27 feet deep at mean low water, 1,000 feet wide from the entrance to Bug Light, 800 feet wide thence to the passage between Georges and Gallops islands, and thence at least 640 feet wide through the remainder of the Narrows into President Roads.

From President Roads to the city the main ship channel is 23 feet deep at mean low water, 1,100 feet wide west of the Upper Middle, 850 feet wide at the Upper Middle, 1,000 feet wide at the Lower Middle.

On March 12, 1898, the following revised estimate was submitted for completing the project of August 11, 1892, under the continuing contracts authorized by the act of June 3, 1896:

For dredging (under contract of February 11, 1897):		
Dredging 2,910,717 cubic yards (more or less), at 17½ cents per cubic yard	$509,375.65	
Contingencies, 20 per cent	101,875.13	
		$611,250.78
Removal of ledge:		
15,000 cubic yards, at $15 per cubic yard	225,000.00	
Contingencies, 10 per cent	22,500.00	
		247,500.00
Total		858,750.78

From the appropriation of $70,000, made by the river and harbor act of June 3, 1896, $45,000 was reserved for expenses under the continuing contracts, and $400,000 was appropriated by the sundry civil act of June 4, 1897, making a total of $445,000 appropriated for the improvement of the main ship channel under the continuing contracts.

The amount, therefore, to be appropriated to complete the project of 1892 is $413,750.78.

On November 19, 1897, a project was submitted for dredging the main ship channel to a depth of 30 feet at mean low water, in accordance with section 9 of the river and harbor act of June 3, 1896.

This project was published as Doc. No. 133, House of Representatives, Fifty-fifth Congress, second session, and in Appendix B 19 of the Annual Report of the Chief of Engineers for 1898.

Improvement of subsidiary channels.—The following-named channels have been improved from time to time, since 1867, under allotments from the general appropriations for Boston Harbor:

Charles River, Fort Point Channel, Nantasket Beach Channel, channel between Nixs Mate and Long Island, Broad Sound, Jeffries Point Channel, and Chelsea Creek.

Of these, the improvement of Nantasket Beach Channel, Nixs Mate Channel, Broad Sound, and Jeffries Point Channel has been completed, and full information thereof is contained in the Report of the Chief of Engineers, 1895, pages 625–627.

Charles River.—This river empties into the inner harbor near the navy-yard at Charlestown.

Before improvement the natural channel had, so far up as Western Avenue Bridge, 4¾ miles from its mouth, 7 feet depth at mean low water, except in several places, covering about 1¼ miles in length below Brookline Street Bridge, where the depth varied from 4½ to 7 feet.

From Western Avenue Bridge to Arsenal Street Bridge (2½ miles) there was a depth of 4 feet at mean low water, and thence to the dam at the head of tide water (1¾ miles) a depth varying from 0 to 9½ feet above mean low water. The mean rise or fall of the tide is 10 feet. A sketch showing the river was published in the Annual Report of the Chief of Engineers for 1884, page 512.

The project for the improvement of this river consists in straightening, widening, and deepening the natural channel so that it shall be from its mouth to Western Avenue Bridge 7 feet deep at mean low water and 200 feet wide; from Western Avenue Bridge to Market Street Bridge 6 feet deep at mean low water and 80 feet wide; thence to the dam at the head of tide water, 60 feet wide and 2 feet deep at mean low water.

The estimated cost of this improvement was originally $85,000. A revised estimate was submitted in 1881 of $125,000.

The total allotments from the appropriations for Boston Harbor for this work to date have been $77,500.

The expenditures to June 30, 1897, were $57,500.

No operations were in progress during the fiscal year, and the condition of the improvement on June 30, 1898, was as follows: The projected channel had been completed from the mouth of the river to Arsenal Street Bridge (7¼ miles). Work was stopped at this point, for the reason that the piers and draws of this bridge do not conform to the projected channel above it. In effecting this improvement 127,971 cubic yards was dredged during the years 1880–1884.

To complete this improvement $47,500 must be allotted.

Fort Point Channel.—This channel is situated between the eastern shore of Boston proper on the one side and the reclaimed and improved flats of South Boston on the other side. It connects the tidal basin of South Bay, which has an area of 250 acres, with Boston inner harbor, is fast becoming the center of the city's most extensive shipping trade, and is the most important branch of the main ship channel. Fort Point Channel is 1¼ miles long.

Before improvement the least depth at mean low water was 12 feet at its entrance and 17 feet above Congress Street Bridge.

That part of it which it is proposed to improve is spanned by bridges at Congress street, Mount Washington avenue, and at an intermediate point. The bridges have conveniently-located draw openings, but the draw piers of the railroad bridge must be strengthened or reconstructed before the improvement can be extended past them, and the width of the draw increased to that of the other bridges above and below it.

The project for this improvement was submitted January 27, 1885. It proposed the excavation of a channel 175 feet wide and 23 feet deep at mean low water from the entrance to near Federal Street Bridge, a distance of 4,100 feet, and was estimated to cost $100,000, the railroad bridge to be reconstructed at the expense of the owners.

By the act of August 5, 1886, $18,750 was allotted for the improvement of this channel from the appropriation for Boston Harbor.

The total expenditures to June 30, 1897, were $18,750.

No operations were in progress during the year, and the condition of the improvement June 30, 1898, is as follows: The channel is dredged

as proposed from its entrance to Congress Street Bridge, a distance of 1,900 feet; 94,211 cubic yards was removed in effecting this improvement during the year 1887.

To complete the improvement, as proposed, to Federal Street Bridge will cost $60,000, and this sum could be expended to advantage during the fiscal year ending June 30, 1900, if the railroad draw shall have been properly reconstructed.

Chelsea Creek (or River).—This river flows into the Mystic River from the east, about 1 mile above the navy-yard at Charlestown.

In its original condition about 14 feet at mean high water could be carried in a narrow and tortuous channel, difficult of navigation.

The project for the improvement of this tributary channel was submitted December 21, 1894. It proposed to dredge a channel 150 feet wide and 18 feet deep at mean high water to the head of navigation, at an estimated cost of $65,000.

But one allotment has been made for this work, $7,000, from the appropriation of $70,000 for Boston Harbor by the act of June 3, 1896.

This allotment was expended in 1896 in the removal from the upper end of the channel of 22,236 cubic yards of material, to facilitate the passage of vessels.

The total expenditures to June 30, 1897, were $7,000.

No operations were in progress during the fiscal year, and at the date of this report the channel is 14 feet deep at mean high water and at least 35 feet wide, with greatly increased widths at turns, up to Proctor's wharf, in Revere.

To complete the improvement as proposed will cost $58,000, all of which could be expended to advantage during the fiscal year ending June 30, 1900.

Recapitulation of amounts which must be appropriated to complete existing projects.

PRESERVATION.

Extension of Point Allerton sea wall	$15,000.00
Sea wall for Georges Island	35,000.00
Sea wall for Governors Island	80,000.00
	130,000.00
Less $18,000 from appropriation river and harbor act of June 3, 1896	18,000.00
Total	112,000.00

IMPROVEMENT.

Subsidiary channels:	
Completion of Charles River improvement	47,500.00
Completion of Fort Point Channel	60,000.00
Completion of Chelsea Creek improvement	58,000.00
Total	277,500.00
Main ship channel:	
To complete project of 1892 under continuing contracts, estimate of March 12, 1898	413,750.78
Total	691,250.78

All of this amount could be expended to advantage during the fiscal year ending June 30, 1900.

The several works completed and projected for the improvement of this harbor are located in the collection district of Boston and Charlestown, Mass. Boston is the port of entry.

Money statements.

PROJECT OF 1867.

July 1, 1897, balance unexpended	$99,253.71
June 30, 1898, amount expended during fiscal year	52,743.35
July 1, 1898, balance unexpended	46,510.36

Amount (estimated) required for completion of existing project	277,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	277,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

PROJECT OF 1892.

July 1, 1897, balance unexpended		$444,956.65
Amount appropriated by sundry civil act approved July 1, 1898		250,000.00
		694,956.65
June 30, 1898, amount expended during fiscal year		58,272.81
July 1, 1898, balance unexpended		636,683.84
July 1, 1898, outstanding liabilities	$32,738.08	
July 1, 1898, amount covered by uncompleted contracts	425,158.17	
		457,896.25

Amount (estimated) required for completion of existing project	163,750.78
Amount that can be profitably expended in fiscal year ending June 30, 1900	163,750.78
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

The dates and amounts of the appropriations for this work are as follows:

Act of—	
March 2, 1825	$52,972.56
March 1, 1828	2,000.00
May 23, 1828	87,000.00
March 2, 1829	7,310.54
March 2, 1831	5,000.00
March 2, 1831	12,390.00
February 24, 1832	9,000.00
July 3, 1832	60,000.00
July 4, 1836	15,000.00
July 7, 1838	7,353.00
March 3, 1841	1,000.00
March 3, 1841	1,500.00
August 31, 1842	2,000.00
March 3, 1843	16,000.00
July 20, 1848	40,000.00
August 30, 1852	30,000.00
July 2, 1864	40,000.00
July 2, 1864	10,000.00
February 28, 1865	3,000.00
February 28, 1865	20,000.00
June 12, 1866	50,000.00
July 12, 1866	75,000.00
March 2, 1867	375,000.00

Act of—	
July 11, 1870	$100,000.00
March 3, 1871	100,000.00
June 10, 1872	75,000.00
March 3, 1873	150,000.00
June 23, 1874	100,000.00
March 3, 1875	100,000.00
August 14, 1876	50,000.00
June 18, 1878	55,000.00
March 3, 1879	50,000.00
June 14, 1880	75,000.00
March 3, 1881	100,000.00
August 2, 1882	96,500.00
July 5, 1884	5,000.00
August 5, 1886	56,250.00
August 11, 1888	125,000.00
September 19, 1890	145,000.00
July 13, 1892	300,000.00
August 18, 1894	200,000.00
June 3, 1896	70,000.00
June 4, 1897	400,000.00
July 1, 1898	250,000.00
Total	3,524,276.10

The accompanying commercial statistics for the fiscal year ending June 30, 1897, have been furnished by the collector of customs at Boston, Mass.

Abstract of proposals for removal of ledges from Boston Harbor, Massachusetts, opened October 22, 1894, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid per cubic yard.	Total.
1	Townsend & Johnston, Somers Point, N. J. *a*	$16.48	$144,562.56
2	P. Sandford Ross, Jersey City, N. J	18.00	157,896.00
3	Geo. Willett Andrews, Biddeford, Me	16.62	145,790.64

a Lowest bid.

The contract was awarded to Townsend & Johnston, with the approval of the Chief of Engineers.

Abstract of proposals for dredging in Boston Harbor, Massachusetts, opened January 28, 1897, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid per cubic yard, measured in scows.	Price bid for removing bowlders weighing over 6 tons each, per cubic yard.	Total.
		Cents.		
1	Charles H. Souther and Augustus R. Wright, Boston, Mass	21⅞	$5	$636,719.56
2	American Dredging Co., by L. Y. Schermerhorn, president, Philadelphia, Pa	29	15	844,108.22
3	Alabama Dredging and Jetty Co., by E. L. Merkel, president, Mobile, Ala	40	8	1,164,287.20
4	Perkins, White & Co. and John J. O'Brien & Co., Boston, Mass	28½	10	829,554.63
5	Baltimore Dredging Co., by F. A. Furst, president, Baltimore, Md	27½	(*a*)	800,447.45
6	John B. & Eugene Breymann, Toledo, Ohio *b*	17½	12	509,375.65
7	Morris & Cummings Dredge Co., by George Leary, president, New York, N. Y	26½	.....	771,340.27

a Informal. *b* Lowest bid.

The contract was awarded to Breymann Brothers, with the approval of the Chief of Engineers.

LIST OF CONTRACTS IN FORCE JUNE 30, 1898.

Contract dated February 11, 1897: Breymann Brothers, of Toledo, Ohio, contractors; to dredge 2,910,718 cubic yards, more or less, of material from the main ship channel, Boston Harbor, Massachusetts, at 17½ cents per cubic yard; approved March 9, 1897; to be commenced April 1, 1897; to be completed June 30, 1900.

COMMERCIAL STATISTICS.

Amount of revenue collected:

1896	$11,219,468.31
1897	12,425,973.65
1898	10,678,299.95

Shipping.	1896.		1897.		1898.	
	No.	Tons.	No.	Tons.	No.	Tons.
Entrances:						
Foreign	1,980	1,650,270	1,805	1,783,726	1,780	1,772,068
Domestic	214	107,021	260	163,153	212	138,402
Clearances:						
Foreign	1,874	1,398,580	1,623	1,475,017	1,673	1,541,315
Domestic	308	124,516	324	159,294	244	120,557

	1896.	1897.	1898.
Imports:			
Merchandise	$79,179,864	$90,178,419	$51,475,094
Coin and bullion		8,724,582	653,740
Exports:			
Foreign merchandise	1,212,826	1,405,676	1,402,676
Coin and bullion	1,200	4,000	
Domestic merchandise	94,638,178	99,451,605	116,129,227
Coin and bullion		1,000	8,100

Number of coastwise arrivals as published by the chamber of commerce: 1894, 8,419; 1895, 9,166; 1896, 9,684.

B 11.

IMPROVEMENT OF TOWN RIVER, MASSACHUSETTS.

Town River is a small tidal river, tributary to Weymouth River, which empties into Boston Harbor on the south.

The wharves of the city of Quincy are about 1½ miles above its mouth.

The upper half of the river has a narrow, crooked channel, in which but 1½ feet of water can be carried at mean low water.

The project for its improvement, submitted December 31, 1890, proposed to dredge a channel 4,500 feet long, 100 feet wide, 4 feet deep at mean low water to the head of navigation, at an estimated cost of $20,000.

On March 24, 1897, the estimate of cost of the project of improvement was revised in accordance with Department letter, dated August 7, 1896, and increased to $25,000. (Annual Report, 1897, p. 848.)

The only appropriation to date was by act of June 3, 1896, $10,000.

The expenditures to June 30, 1897, were $105.72.

At that date no improvement of the channel had been secured, but operations were in progress under a contract with Messrs. Perkins & White to dredge 33,000 cubic yards from the river at 27 cents per cubic yard, scow measurement.

Operations under this contract were continued during the fiscal year until satisfactorily completed on September 4, 1897.

Thirty-four thousand four hundred and ninety-four cubic yards were removed under the contract, and at the date of this report the improved channel is 4 feet deep at mean low water, 50 feet wide up to Johnson's wharf, a distance of 3,500 feet, and 30 feet wide for a further distance of 800 feet.

To complete the improvement would require an appropriation of

$15,000, all of which could be expended during the fiscal year ending June 30, 1898.

Town River, Massachusetts, is in the collection district of Boston, Mass., of which Boston is the port of entry. The nearest light-house is on Long Island, Boston Harbor, Massachusetts.

The local commerce consists of coal, lumber, etc., and the output of the Quincy granite quarries.

The value of this commerce annually will approximate $200,000.

Money statement.

July 1, 1897, balance unexpended	$9,894.28
June 30, 1898, amount expended during fiscal year	9,651.71
July 1, 1898, balance unexpended	242.57
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

The date and amount of appropriation for this work is as follows:

Act of June 3, 1896 ..... $10,000

Abstract of proposals for dredging in Town River, Massachusetts, opened September 28, 1896, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid per cubic yard.		Total yards that can be dredged.
		For dredging.	Bowlders over 3 tons each.	
		Cents.		
1	Perkins & White, Boston, Mass. a	27	$8	37,037
2	Charles H. Souther, Boston, Mass	45	10	22,222
3	Augustus B. Martin, Boston, Mass	35	5	28,571
4	Eastern Dredging Co., Boston, Mass	32	3	31,250

a Lowest bid.

The contract was awarded to Messrs. Perkins & White, with the approval of the Chief of Engineers.

B 12.

IMPROVEMENT OF WEYMOUTH RIVER, MASSACHUSETTS.

Weymouth (Fore) River empties into the southwestern part of Boston Harbor, Massachusetts. For 4 miles it was navigable at low water for vessels drawing 18 feet, and to the head of navigation, an additional 3 miles, at least 3 feet depth was to be found.

The original project for its improvement was submitted December 2, 1889. It proposed to improve the natural channel so that 6 feet at mean low water could be carried to the head of navigation in a channel 100 feet wide to near Weymouth Landing, thence to Braintree Bridge 80 feet wide and above the bridge 50 feet wide, the total length of improved channel to be 7,000 feet and to cost $40,000.

The total appropriations to date have been $40,000, of which $12,500 must be expended on the "Back" River.

The expenditures to June 30, 1897, were $26,749.42, and at that date

the improved channel was 6 feet deep and 60 feet wide up to Braintree Bridge, and was completed above the bridge, excepting over four small ledges uncovered by the dredging in 1897.

No operations have been in progress during the fiscal year, and at the date of this report the condition of the improvement is the same as on June 30, 1897.

Weymouth (Back) River lies east of the Fore River and forms the boundary between the towns of Weymouth and Hingham. It empties into Boston Harbor at the mouth of Fore River.

Originally 6 feet at mean low water could be carried to the wharf of the Bradley Fertilizer Company, a distance of 7,000 feet. For a farther distance of about 8,800 feet a channel exists navigable only at high water.

The project for the improvement of Weymouth (Back) River was submitted February 7, 1891. It proposed to dredge a channel through the outer bar 200 feet wide and 12 feet deep at mean low water, and to widen and deepen the natural channel of the river to the same dimensions, to the wharf of the fertilizer company, at an estimated cost of $22,000.

On March 15, 1897, a project for the further improvement of this river was submitted. It proposed to dredge a channel 60 feet wide and 4 feet deep at mean low water from the wharf of the Bradley Fertilizer Company up to Mann's wharf, at an estimated cost of $49,834.01. (House Doc. No. 12, Fifty-fifth Congress, first session.) (Annual Report, 1897, p. 874.)

No appropriations have as yet been made for the execution of this project.

The appropriations to date have been $12,500.

The expenditures to June 30, 1897, were $11,704.19.

At that date the channel had been dredged 12 feet deep at mean low water, 200 feet wide through the outer bar, and 125 feet wide thence to the Fertilizer Company wharf.

No operations have been in progress during the fiscal year, and at the date of this report the condition of the improvement is the same as on June 30, 1897.

The amount required to complete the improvement of Weymouth (Fore) River is $12,500; to complete Weymouth (Back) River, project of 1891, $9,500; total, $22,000.

Weymouth River is in the collection district of Boston, Mass., of which Boston is the port of entry. The nearest light-house is on Long Island, Boston Harbor, Massachusetts.

Money statement.

July 1, 1897, balance unexpended	$1,546.39
July 1, 1898, balance unexpended	1,546.39
Amount (estimated) required for completion of existing project	22,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	22,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

The dates and amounts of the appropriations for this work are as follows:

By act of—	
September 19, 1890	$10,000
July 13, 1892	10,000
August 18, 1894	5,000
June 3, 1896	15,000
Total	40,000

No contracts were in force on June 30, 1898.

Commercial statistics are included in the statement for Boston Harbor, Massachusetts.

The character of commerce benefited by the improvement of this river is the supply of coal, lumber, and general merchandise to the populous district surrounding it. The annual value of this commerce approximates $750,000.

B 13.

IMPROVEMENT OF THE HARBOR AT SCITUATE, MASSACHUSETTS.

Scituate Harbor is on the west shore of Massachusetts Bay, 14 miles from either Boston or Plymouth lighthouses, and just southwest of the direct sailing course of all ocean-going vessels entering Boston Harbor.

Before improvement the harbor had a low-water area of 57 acres, approximately, more than 6 acres of which had a depth of at least 3 feet at mean low water. It was entirely open to the action of east winds, and the entrance was obstructed by many sunken bowlders. The depth on the bar was about 2½ feet at mean low water. The mean rise or fall of the tide is 9.8 feet.

The object of the improvement is to create a harbor of refuge for vessels bound to Boston, which are too far south of their course to clear the dangerous ledges near Minots Light-house.

The project of improvement, adopted in 1881, is to build two rubble-stone breakwaters converging from opposite shores, and to dredge an anchorage basin connecting with the sea and the town wharves. The anchorage basin is to be 30 acres in area, approximately. The entrance channel is to be 2,700 feet long and 300 feet average width. The depths proposed were 15 feet in the entrance channel, 12 to 15 feet between the breakwaters, 12 feet immediately in the rear of the south breakwater, and 10 feet for the anchorage basin; the channel leading to the town wharves is to be 3 feet deep, all at mean low water.

The estimated cost of the breakwaters was $100,000, and of dredging, $190,000; a total of $290,000.

The plan of the harbor, showing the proposed improvement, was published in the Annual Report of the Chief of Engineers for 1881, Part I, page 522.

The total amount appropriated for this work to date is $89,680, of which $1,180 was expended before the present project was adopted.

The amount expended to June 30, 1897, was $82,616.53.

At that date the condition of the improvement was as follows:

A portion of the beach between Cedar Point and the mainland was protected by a brush-and-stone bulkhead 450 feet long, in front of which was a stone apron 10 feet wide, 385 feet long.

All known bowlders obstructing the entrance of the harbor were removed.

The anchorage basin was 400 by 350 feet in area, 7 feet deep at mean low water.

The entrance channel was 1,600 feet long, 100 feet wide, and 5 feet deep at mean low water. The channel connecting the basin with the town wharves was 3 feet deep at mean low water, and 100 feet wide, except at the upper end, where, for a distance of 75 feet, it averaged only 50 feet wide.

The north breakwater was 720 feet long, the south breakwater 450 feet long.

A contract was in force with the Eastern Dredging Company to dredge 14,000 cubic yards, more or less, of material from the entrance channel.

Operations were in progress under this contract on June 30, 1897, and were continued during the fiscal year, until completed on July 21, 1897, and under it the entrance channel was deepened to 7 feet at mean low water in a cut 100 feet wide.

At the date of this report the condition of the improvement in all other respects is the same as on June 30, 1897.

Scituate Harbor is in the collection district of Plymouth, Mass.

Money statement.

July 1, 1897, balance unexpended	$5,883.47
June 30, 1898, amount expended during fiscal year	5,499.39
July 1, 1898, balance unexpended	384.08
Amount (estimated) required for completion of existing project	201,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	30,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

The dates and amounts of the appropriations for this work are as follows:

Act of—		Act of—	
March 2, 1829	$180	August 11, 1888	$5,000
August 30, 1852	1,000	September 19, 1890	10,000
June 14, 1880	7,500	July 13, 1892	10,000
March 3, 1881	10,000	August 18, 1894	10,000
August 2, 1882	10,000	June 3, 1896	6,000
July 5, 1884	10,000		
August 5, 1886	10,000	Total	89,680

Abstract of proposals for dredging in Scituate Harbor, Massachusetts, opened September 28, 1896, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid per cubic yard.		Total yards that can be dredged.
		For dredging.	Bowlders over 3 tons each.	
		Cents.		
1	Charles H. Souther, Boston, Mass.	45	$8	13,333
2	Augustus B. Martin, Boston, Mass	45	5	13,333
a 3	Eastern Dredging Co., Boston, Mass.	38½	3	15,584

a Lowest bid.

The contract was awarded to the Eastern Dredging Company, with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

The accompanying commercial statistics have been furnished by the collector of customs at Plymouth, Mass.

Amount of revenue collected, 1897, $76.47.

Shipping.	1896.		1897.		1898.	
	No.	Tons.	No.	Tons.	No.	Tons.
Entrances:						
Foreign	1	400	3	290	3	.....
Domestic	39	5,840	42	.....	25	.....
Clearances:						
Foreign	1	400	3	290	3	.....
Domestic	39	5,840	42	.....	25	.....

Imports.	1896.	1897.	1898.
Coal ... tons	5,000	5,000	3,500
Lumber ... feet	3,000,000	3,500,000	2,000,000
Lime and cement ... barrels	.....	1,500	.....
Brick ... number	.....	450,000	500,000
Shingles ... do	.....	.....	3,000,000
Miscellaneous ... barrels	a 10,000	a 15,000	b 1,000

a Irish moss exported. b Lime.

Vessels frequenting the harbor, two and three-masted schooners; draft of water, 10 to 12 feet.

B 14.

IMPROVEMENT OF THE HARBOR AT PLYMOUTH, MASSACHUSETTS.

Plymouth Harbor is situated 30 miles south of Boston. Its outer anchorage, the "Cow Yard," is common to Plymouth, Kingston, and Duxbury, and is the only refuge for seagoing vessels from northeasterly gales when caught between Boston and Provincetown, a distance of about 75 miles, following the coast line. The entrance to this outer anchorage is direct, unobstructed, of ample width, and sufficiently deep for the wants of commerce. The anchorage is capacious and has good "holding ground," but the extensive tidal basins inside of it give strong variable currents across it.

The inner or harbor proper is formed by Long Beach, a narrow, low sand spit 3 miles long, which extends generally parallel to the mainland and about 1 mile from it.

The harbor contains about 2,000 acres, almost all of which is dry at low tide. A few narrow, crooked channels traverse these flats. They join about the center of the harbor, opposite the town wharves, and form the main ship channel (150 feet wide, approximately, and 10 feet deep at mean low water), which runs directly behind the northern half of Long Beach to the outer anchorage.

The maintenance of this inner harbor or channel depends on the preservation of Long Beach.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for the year 1888, Part I, page 460.

Before improvement about 6 inches depth of water could be carried to the town wharves at low tide.

Previous to 1875 the project was a general one, and had for its object the preservation of Long Beach. From the nature of the work it can

at no time be considered completed, and small annual appropriations are necessary to repair any damages done by storms. The various devices employed for this purpose are described in the Annual Report of the Chief of Engineers for 1877.

The project for the improvement of the harbor was first adopted in 1875. It provided for dredging a channel from the town wharves to the main ship channel, 2,286 feet long, 100 feet wide, and 6 feet deep at mean low water. This project was modified in 1877 so as to include the dredging of a basin 866 feet long, 150 feet wide, and 8 feet deep directly in front of the town wharves.

In 1884 and 1885 it was proposed to deepen the channel and basin to 9 feet at mean low water, and to make the channel 150 feet wide.

The modified project of 1884 required the excavation of 81,000 cubic yards (scow measurement), and was originally estimated to cost $27,000. This estimate was revised in 1885 in accordance with the low prices then current for dredging, and the cost was then estimated to be $22,500.

The river and harbor act of June 3, 1896, ordered a survey to be made and project submitted for further improvement of the harbor, and on April 24, 1897, a plan and project for improvement were submitted, the estimated cost of which was $8,716.95.

This report and project were published as House Doc. No. 39, Fifty-fifth Congress, first session; also Annual Report, Chief of Engineers, 1897, page 877.

From 1824 to date the amount appropriated for this harbor is $182,-766.90, of which there has been expended to June 30, 1897—

For beach protection	$128,353.73
For dredging	50,514.89
Total	178,868.62

On June 30, 1897, the project of 1884–1885 for improvement had been completed. Long Beach was in good order.

An examination of the dredged channel and basin was made in January, 1898.

No other operations were in progress during the fiscal year.

At the date of this report the condition of the improved channel is good, but the anchorage basin has shoaled so that its upper end has but 2 feet of water at mean low water, and requires redredging, which is provided for in the project submitted April 24, 1897.

The condition of the beach generally is satisfactory, but the winter storms of 1897–98 weakened it in places, which may require protection during the present summer.

A small sum should always be available for the harbor to immediately repair any damage made to Long Beach by storms. These necessary repairs have averaged in the last twenty years $1,500.

Plymouth Harbor is in the collection district of Plymouth, Mass., of which Plymouth is the port of entry. The nearest light-houses are the Plymouth (Gurnet) Lights, about 5 miles from Plymouth, and Duxbury Pier Light, about 2 miles distant.

Money statement.

July 1, 1897, balance unexpended	$3,898.28
June 30, 1898, amount expended during fiscal year	949.34
July 1, 1898, balance unexpended	2,948.94

The dates and amounts of appropriations for this harbor are as follows:

Act of—		Act of—	
May 26, 1824	$20,000.00	June 23, 1874	$5,000.00
March 3, 1825	5,712.00	March 3, 1875	10,000.00
March 25, 1826	13,184.90	June 18, 1878	5,000.00
April 23, 1830	1,850.00	March 3, 1879	3,500.00
March 2, 1831	2,820.00	June 14, 1880	10,000.00
July 3, 1832	2,500.00	March 3, 1881	10,000.00
March 2, 1833	600.00	August 2, 1882	14,000.00
June 28, 1834	2,000.00	July 5, 1884	10,000.00
March 3, 1835	700.00	August 5, 1886	6,000.00
July 2, 1836	500.00	August 11, 1888	6,000.00
July 7, 1838	2,400.00	September 19, 1890	8,000.00
August 31, 1852	5,000.00	July 13, 1892	9,500.00
July 11, 1870	10,000.00	August 18, 1894	1,500.00
March 3, 1871	10,000.00	June 3, 1896	1,500.00
June 10, 1872	2,500.00		
March 3, 1873	3,000.00	Total	182,766.90

COMMERCIAL STATISTICS.

The accompanying commercial statistics have been furnished by the collector of customs at Plymouth, Mass.

Amount of revenue collected, 1896, $3,780.43; 1897, $1,750.26; 1898, $2,887.21.

Shipping.	1896.		1897.		1898.	
	No.	Tons.	No.	Tons.	No.	Tons.
Entrances:						
Foreign	6	.....	8	766	a 1	.....
Domestic	90	.....	.....	.....	a 73	.....
Clearances:						
Foreign	13	.....	9	1,071	3	.....
Domestic	3	.....	.....	.....	71	.....

Imports.	1896.	1897.	1898.
	Tons.	*Tons.*	*Tons.*
Coal	24,832	22,566	23,521
Iron	791	725	.....
Lumber	b 1,400,000	b 3,400,000	b 2,400,000
Sand	160	320	.....
Miscellaneous	c 3,486	.....	130

a Value, $104,000. b Feet. c Stone.

Barges and schooners of an average draft of 13 feet frequent the harbor.

B 15.

IMPROVEMENT OF HARBOR AT PROVINCETOWN, MASSACHUSETTS.

Provincetown Harbor is situated at the extremity of Cape Cod, about 40 miles southeast from Boston Light. It is one of the most valuable harbors of refuge on the Atlantic coast. The entire commerce of New England and a very large local fishing interest are directly benefited by its maintenance, which depends entirely on the preservation of the sandy beaches which inclose it.

Since 1826 the project has been a general one, and provides for the

preservation of the harbor by building dikes, bulkheads, and sand catches, and extensive planting of beach grass to repair or prevent storm damages to the beaches. From the nature of the work it can at no time be considered completed.

A full history of the improvement will be found in the Annual Report of the Chief of Engineers for the years 1876, 1879, and 1886. A special dike across House Point Island Flats, to be built contingently, was recommended in the Annual Report for 1886.

A plan of the harbor was published in the Annual Report of the Chief of Engineers for 1886.

The river and harbor act of June 3, 1896, ordered a survey of the harbor, "with a view of erecting a dike for the protection of that harbor."

This survey was made in October, 1896, and the plan and report of the survey were submitted to the Department March 1, 1897, and were published as House Doc. No. 8, Fifty-fifth Congress, first session.

The survey showed that no material alteration had occurred in House Point Island Flats, but continued weakening of the beach on the harbor side near Wood End Light was shown, and the report recommended the protection of the beach on the harbor side in that vicinity by means of a stone riprap, estimated to cost $13,200.

The total appropriations for this harbor to date are $155,918.44.

The amount expended to June 30, 1897, was $149,876.17.

The condition of the several works of preservation in this harbor on June 30, 1897, was as follows:

Long Point.—This long, narrow, low point forms the southeastern limit of the harbor. Works of preservation have been built at its northeastern end, protecting the Long Point light-house reservation at a point near the Wood End Light where the beach is exceedingly narrow and low, and at its northwestern end near Abel Hill. These works of protection were in good order.

Abel Hill Dike.—This dike was built to prevent a rush of water from Lanceys Harbor over House Point Island Flats into the main harbor. The rapid wearing away of the southern sand spit that formed Lanceys Harbor had threatened to make a breach through the beach south of the dike. To guard against this, brush and wooden sand catches have been built on the outer beach opposite the west end of the dike. The dike was in good order.

House Point Island Flats.—These flats remained essentially unaltered. It still appears unnecessary to commence the dike projected to be built across these flats.

Beach Point, High Head Dike, and Cove Section.—These works were all in good order.

Additional works of protection were required near Wood End Light.

During the fiscal year the work of protection near Wood End Light was extended about 227 feet and a portion of the old work was repaired. The beach at this point is now in fair order, but the riprap recommended March 1, 1897, must be built before the beach at this point can be considered safe.

The works protecting the northeastern end of Long Point will soon require extension to the northwest.

With these exceptions the works of preservation at the date of this report are in good order and fulfilling satisfactorily the purpose for which they were built.

The nature of the works of preservation of the harbor requires a small sum to be always available for immediate repairs.

Such necessary repairs have averaged $1,500 per annum.

The prospective benefit to commerce is the preservation of an important harbor of refuge.

The accompanying commercial statistics have been furnished by the collector of customs at Barnstable, Mass.

Provincetown is a port of entry in the collection district of Barnstable, Mass. The nearest light-houses are Wood End and Long Point lights.

Money statement.

July 1, 1897, balance unexpended	$6,042.27
June 30, 1898, amount expended during fiscal year	556.98
July 1, 1898, balance unexpended	5,485.29

The dates and amounts of the appropriations for this work are as follows:

Act of—		Act of—	
May 19, 1826	$3,500.00	August 14, 1876	$4,000.00
March 2, 1829	3,500.00	June 18, 1878	1,000.00
March 2, 1831	2,050.00	March 3, 1879	1,000.00
March 3, 1832	4,600.00	June 14, 1880	500.00
June 28, 1834	4,400.00	March 3, 1881	5,000.00
March 3, 1835	4,400.00	August 2, 1882	5,000.00
July 2, 1836	4,400.00	July 5, 1884	2,000.00
July 7, 1838	4,500.00	August 5, 1886	3,000.00
August 30, 1852	5,000.00	August 11, 1888	3,000.00
June 23, 1866	43,068.44	September 19, 1890	7,500.00
July 28, 1866	8,000.00	July 13, 1892	1,500.00
March 3, 1871	6,000.00	August 18, 1894	1,500.00
June 10, 1872	5,000.00	June 3, 1896	1,500.00
March 3, 1873	6,000.00		
June 23, 1874	6,000.00	Total	155,918.44
March 3, 1875	5,000.00		

COMMERCIAL STATISTICS.

Amount of revenue collected, 1896, $196.40; 1897, ——; 1898, $1,439.28.

Shipping.	1896.		1897.		1898.	
	No.	Tons.	No.	Tons.	No.	Tons.
Entrances:						
Foreign	14	2,757	12	2,559	23	3,450
Domestic	7	810	5	708		
Clearances:						
Foreign	12	1,246	9	1,025	15	2,250
Domestic	6	2,250	6	1,403		

Imports.	1896.	1897.	1898.
	Tons.	*Tons.*	*Tons.*
Coal	6,000	5,500	6,000
Iron	40	35	.....
Flour	a 2,900	a 2,700	.....
Grain	575	600	.....
Lumber	b 960,000	b 850,000	b 1,500
Salt	.....	286	250
Tin	.....	35	.....
Wood	c 300	c 350	.....
Merchandise	2,360	3,949	3,000
Miscellaneous	.....	.....	13,000

a Barrels. b Feet. c Cords.

All classes and nationalities of vessels visit the harbor for shelter or with cargo. Estimated value of vessels which enter the harbor during the year, $40,000,000.

B 16.

IMPROVEMENT OF HARBOR AT CHATHAM, MASSACHUSETTS.

Chatham Harbor is at the eastern end of Nantucket Sound, about 15 miles east of Hyannis, Mass. Its outer anchorage, known as Chatham Roads, is a capacious, deep, unobstructed harbor of refuge from northerly and easterly gales.

The inner harbor, locally known as "Stage" Harbor, is small but well landlocked. It is about one-half mile long, 500 to 600 feet wide, and has 8 to 12 feet depth at mean low water. Its entrance was originally obstructed by three bars, on which the depth at mean low water was not to exceed 4 feet. The mean rise or fall of the tide is 5 feet.

The project for the improvement of the inner harbor was submitted December 19, 1890, and was based on a survey made in October, 1890. It proposed to dredge a channel 6 feet deep at mean low water through the three obstructing bars, 100 feet wide at the inner bar, 150 feet wide at the middle bar, and 200 feet wide at the outer bar, at an estimated cost of $10,000.

On March 24, 1897, a revised estimate of cost of the project was submitted, in accordance with Department letter 16423, August 7, 1896.

This estimate increased the cost of the improvement $3,732.79, the increase being necessary because of the small amount of work to be done and the distance of Chatham Harbor from large ports where dredging plants are maintained.

The total appropriations to date have been $10,000.

The expenditures to June 30, 1897, were $4,426.10.

At that date the improved channel through the middle and inner bars was 100 feet wide, 6 feet deep at mean low water. Nothing had been done on the outer bar. At least 5 feet draft could be carried into the harbor at mean low water.

On June 20, 1896, a project was submitted for the expenditure of $5,000, appropriated by the river and harbor act of June 3, 1896, and on August 29, 1896, advertisement was published calling for bids for the proposed work to be opened on September 29, 1896.

No bids were received in answer to the advertisement, and on May 19, 1897, it was recommended that the funds available for this work be retained in the Treasury until further funds are provided.

No other operations were in progress during the fiscal year, and at the date of this report the condition of the improvement is the same as on June 30, 1897.

Chatham Harbor is in the collection district of Barnstable, Mass., of which Barnstable is the port of entry. The nearest light-house is Hardings Beach Light.

Money statement.

July 1, 1897, balance unexpended	$5,573.90
July 1, 1898, balance unexpended	5,573.90
Amount (estimated) required for completion of existing project	3,732.79
Amount that can be profitably expended in fiscal year ending June 30, 1900	3,732.79
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

The dates and amounts of appropriations for this harbor are as follows:

Act of—	
September 19, 1890	$5,000
June 3, 1896	5,000
Total	10,000

COMMERCIAL STATISTICS.

The accompanying commercial statistics have been furnished by the collector of customs at Barnstable, Mass.:

Imports.	1896.	1897.	1898.
	Tons.	*Tons.*	*Tons.*
Coal	1,200	1,200	1,300
Lumber	a 12,000	a 20,000	a 100,000
Miscellaneous	b 5,000	c 2,000	525

a Feet. b Bushels of oysters. c Bushels.

Vessels of all kinds drawing from 2½ to 8 feet frequent the harbor for shelter or with cargo.

Estimated value of vessels which enter the harbor during the year, $40,000,000.

B 17.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

On May 13, 1897, the wreck of the schooner *Annie E. Rudolph* (official number 106315) was reported to be such an obstruction to navigation as is contemplated by section 4 of the river and harbor act of June 14, 1880, and it was recommended that it be removed by the United States, at an estimated cost of $750.

The wreck was about 2½ miles E. by N. of Orleans, Cape Cod, Massachusetts, in about 66 feet of water at low tide, and if the masts and spars were removed the hull would present no obstruction to navigation.

On May 20, 1897, an allotment of $750 was made for this work.

Proposals were invited by public advertisement, dated June 29, 1897.

The bids received were opened July 29, 1897, and an abstract of them will be found in the annexed table.

On August 9, 1897, a contract was entered into with the lowest bidder, Mr. L. E. Lunt, of Malden, Mass., and the wreck was satisfactorily removed by the contractor by August 18, 1897, at a cost of $192.15.

On February 15, 1898, a portion of the wreck of a vessel, name unknown, lying in the Old Harbor, Chatham, Mass., was reported to be such an obstruction to navigation as is contemplated by section 4 of the river and harbor act of June 14, 1880, and it was recommended that it be removed by the United States at an estimated cost of $800.

On March 3, 1898, an allotment of $800 was made for this work.

Proposals were invited by public advertisement dated March 29, 1898.

The bids received were opened April 29, 1898, and an abstract of them will be found in the annexed table.

On May 10, 1898, a contract was entered into with the only bidder, Mr. Joseph N. Bloomer, of Chatham, Mass., and the wreck was satisfactorily removed by the contractor by May 20, 1898, at a cost of $402.36.

Abstract of proposals for removal of wreck from off Orleans, Mass., received in response to advertisement dated June 29, 1897, and opened July 29, 1897, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name.	Address.	Price bid for examination of wreck.	Price bid for removal of wreck.	Remarks.
1	L. E. Lunt a	Malden, Mass	$134.40	$234.40	Informal.
2	Charles W. Johnston	Sullivan, Me	175.00	275.00	Do.

a Lowest bid.

The contract was awarded to Mr. L. E. Lunt with the approval of the Chief of Engineers.

Abstract of proposals for removing wreck from Chatham Harbor, Massachusetts, received in response to advertisement dated March 29, 1898, and opened April 29, 1898, by direction and in the absence of Lieut. Col. S. M. Mansfield, Corps of Engineers, by First Lieut. John Stephen Sewell, Corps of Engineers.

No.	Name.	Residence.	Aggregate amount bid.	Remarks.
1	Joseph N. Bloomer	Chatham, Mass	$332.42	Lowest bid.

The contract was awarded to Mr. Joseph N. Bloomer with the approval of the Chief of Engineers.

B 18.

SURVEY OF MERRIMAC RIVER, MASSACHUSETTS, FROM LOWELL TO OLD NEW HAMPSHIRE STATE LINE.

[Printed in House Doc. No. 242, Fifty-fifth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 17, 1898.

SIR: I have the honor to submit the accompanying report, dated January 8, 1898, with map,* by Lieut. Col. S. M. Mansfield, Corps of Engineers, of the results of a survey made of Merrimac River, Massachusetts, from Lowell to the New Hampshire State line, to comply with requirements of the river and harbor act of June 3, 1896.

The river flows in a tortuous course between high banks, with a continuous depth of about 6½ feet for a least width of 250 feet between 6-foot contours, and Colonel Mansfield states that it is easily navigable by the class of boats which use it. The river seems to afford ample accommodations for the present and prospective navigation interests, and in view of this fact, and in the absence of any indication by Congress of the dimensions of channel intended, no estimate for any improvement of the stream is submitted by Lieutenant-Colonel Mansfield.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF LIEUT. COL. S. M. MANSFIELD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., January 8, 1898.

GENERAL: In accordance with instructions of September 5, 1896, I have the honor to submit the following report (accompanied with a tracing) of the survey of Merrimac River, Massachusetts, from Lowell to the New Hampshire State line, as provided for in the river and harbor act of June 3, 1896.

The Merrimac River is closed at the city of Lowell by a dam for the purpose of creating a reservoir of water to furnish power to the large

* Not reprinted. Printed in House Doc. No. 242, Fifty-fifth Congress, second session.

mills forming the greater portion of that city's industries. A canal around the dam affords communication with the river below for very small craft, but is rarely used.

No preliminary examination of the river above the dam has ever been authorized or reported upon.

The present survey was made during the months of November and December, and covers a stretch of about 8 miles of river. For the details thereof I invite attention to the chart and accompanying report of Assistant Engineer T. T. Hunter Harwood, wherein it appears that the river flows in a tortuous course between high banks, with a continuous depth of about 6½ feet for a least width of 250 feet between the 6-foot contours; that it is easily navigable by the class of boats which use it, there being some little difficulty, however, in time of low water in passing the remains of an old dam built across the river at Tyngs Island some years ago. This dam is submerged to a depth of 6 feet below the adopted plane of reference of the survey, and has a gap of 25 feet, carrying over 10 feet of water, which relieves the difficulties experienced at time of low water so far as depth of water is concerned; and at Tyngsboro the river is spanned by a highway bridge without a draw opening.

The navigation interests are merely nominal; a few small steam launches and rowboats are used for pleasure purposes only, while the river carries annually from 4,000,000 to 6,000,000 feet of timber to the sawmills at Lowell. In view of the above, I am of the opinion that the Merrimac River between the city of Lowell and the New Hampshire State line is unworthy of improvement by the General Government, and therefore no estimate for its improvement is submitted.

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

REPORT OF MR. T. T. HUNTER HARWOOD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., January 7, 1898.

COLONEL: I have the honor to submit the following report upon the survey of Merrimac River, Massachusetts, from Lowell to the New Hampsire State line, made in November and December, 1897, in accordance with your instructions, and with it a plan of the survey drawn to a scale of 1=6,000.

The stretch of river to be covered by the survey was about 8 miles in length.

A triangulation system was established along the banks of the river containing 117 points. Great difficulty was encountered in making this triangulation because of the heavy growth of woods and underbrush along the banks of the river. By means of these triangulation points 113 ranges for sounding were laid out about 400 feet apart and approximately at right angles to the axis of the channel.

On these ranges 6,338 soundings were taken and were located by angles of intersection taken with a transit from suitable shore stations. The shore lines shown on plan resulted from a reduction of these soundings to the plane of reference adopted for plotting the hydrography of the survey.

Description of channel as developed by the survey.—The river is closed at Lowell by a dam for the purpose of creating a head of water as power for the large mills forming the greater portion of that city's industry.

Passage from the lower Merrimac River around this dam is rendered possible for small boats only by means of a small canal, known as Pawtucket Canal, the lower outlet of which is in the Concord River, which flows into the Merrimac River below Hunts Falls. About 4 feet draft of water can be carried through this canal. The canal at its upper outlet is 95 feet wide, and is crossed by a highway bridge without draw opening, supported in the center by a pier. The height of this bridge above the surface of the water is about 10 feet.

The plane of reference adopted for the reduction of the soundings of the survey is the top of the flashboards as they at present exist off the dam at Lowell.

Variations from this level frequently occur, caused by the fluctuating supply of water furnished by the watershed of the upper Merrimac River.

The Locks and Canal Company at Lowell maintain a standard gauge at the dam, readings of which are recorded every hour. The highest recorded rise in recent years above the adopted plane of reference is 9.8 feet, on March 3, 1896, and the lowest recorded fall below the same plane is 6.75 feet, on September 15, 1883.

Gauges for use in the survey were set from bench marks which had been established at intervals along the banks of the river in connection with this standard gauge by the Locks and Canal Company.

The river from New Hampshire State line to Lowell, Mass., flows in a tortuous course between high banks, its general direction being easterly.

The greatest continuous depth of channel, as developed by the survey, is about 6½ feet, with a least width of 250 feet between the 6-foot contours. It is easily navigable by the class of boats which use it, the place where it is at all difficult being at Tyngs Island, where there is an old dam crossing the river from the westerly shore to the island.

This dam is submerged under about 6 feet of water below the adopted plane of reference, but at low-water stages of the river forms an obstruction to navigation. It is constructed of logs, stone, and earth, and some years ago a section of about 25 feet was removed to facilitate the passage of boats, affording an increased depth of 4 feet in the gap.

At Tyngsboro the river is spanned by a highway bridge without a draw opening.

The operations of the party in the field were in charge of Mr. Thomas J. Finn, United States hydrographer. Mr. Finn made careful inquiry as to the commerce on the river and the number and character of vessels employed therein, with results as follows:

From 1887 to 1891 15 steam launches, with a total tonnage of 495 tons, passed through the canal. In 1893 3 sailboats, with a total tonnage of 20 tons, passed through. From 1893 to the present date nothing but rowboats have made use of the canal.

Up to 1890 about 1,000,000 feet of logs were rafted through each year.

The canal has not been used for that purpose since that date, owing to the removal of the sawmill to above the dam.

The commerce of the river is confined to the rafting of about 4,000,000 to 6,000,000 feet of timber each year between Nashua, N. H., and Lowell, Mass.

A few small steam launches and rowboats are owned on the river as pleasure crafts, and formerly two excursion steamers plied between Nashua and Lowell, but have recently been discontinued.

Very respectfully, your obedient servant,

T. T. HUNTER HARWOOD,
U. S. Assistant Engineer.

Lieut. Col. S. M. MANSFIELD,
Corps of Engineers, U. S. A.

B 19.

SURVEY OF BOSTON HARBOR, MASSACHUSETTS, WITH A VIEW TO SECURING A CHANNEL 1,200 FEET WIDE AND 30 FEET DEEP FROM THE NAVY-YARD TO THE ENTRANCE OF THE PRESENT MAIN SHIP CHANNEL, AND FROM THE MAIN SHIP CHANNEL IN PRESIDENT ROADS THROUGH BROAD SOUND CHANNEL.

[Printed in House Doc. No. 133, Fifty-fifth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 3, 1897.

SIR: I have the honor to submit the accompanying copy of report, dated November 19, 1897, with map,* by Lieut. Col. S. M. Mansfield, Corps of Engineers, giving the results of a survey of Boston Harbor, Massachusetts, with a view to securing a channel 1,200 feet wide and

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*Not reprinted. Printed in House Doc. No. 133, Fifty-fifth Congress, second session.

30 feet deep from the navy-yard to the entrance of the present main ship channel, and from the main ship channel in President Roads through Broad Sound Channel, made to comply with the provisions of the river and harbor act of June 3, 1896.

Provision has been made by the river and harbor acts of 1892, 1894, and 1896 for improving the main ship channel so that it shall have a width of 1,000 feet, with a minimum depth of 27 feet. The project for obtaining these channel dimensions is now being executed, and thus far there has been secured a channel of the full depth of 27 feet, 1,000 feet wide from the entrance of the harbor to Bug Light, 800 feet wide from Bug Light to the passage between Georges and Gallops islands, and thence 550 feet wide through the Narrows to President Roads.

Colonel Mansfield states that a great deal of rock in place will still have to be removed from the main ship channel to complete the present work of excavation, and to enlarge this channel to the contemplated dimensions will, it is estimated, cost $1,557,621.72. The estimated cost of enlarging the channel from the navy-yard to President Roads is $1,644,553.90. The proximity of the deep water of Broad Sound and President Roads has suggested the possibility of a direct and superior entrance to Boston Upper Harbor, and Colonel Mansfield is of opinion that the channel between them could readily be improved to the dimensions required, and at a small cost compared with the expense of improving the channel through the Narrows. The cost of this new channel through Broad Sound is estimated at $481,941.57.

For the reasons given in the report, Colonel Mansfield is of opinion that the harbor is worthy of improvement to the extent of providing a channel 1,200 feet wide and 30 feet deep from the navy-yard to President Roads, and from President Roads through Broad Sound Channel, and that work on the latter portion should be executed first. Owing to the difficulties and the expense attending the work he does not recommend the increasing of the dimensions of the lower main ship channel, as it is thought that the proposed improvement of the Broad Sound Channel will amply meet the requirements of navigation.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers,
U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF LIEUT. COL. S. M. MANSFIELD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., November 19, 1897.

GENERAL: I have the honor to submit the following report upon a survey of Boston Harbor, Massachusetts, with an estimate of cost, to secure a channel 1,200 feet wide and 30 feet deep from the navy-yard to the entrance of the present main ship channel, and from the main ship channel in President Roads through Broad Sound Channel, in compliance with the requirements of section 9 of the river and harbor act of June 3, 1896, and your instructions of September 5, 1896:

Under the river and harbor acts of 1892, 1894, and 1896, provision has been made for improving the main ship channel so that it shall have a width of 1,000 feet and a minimum depth of 27 feet.

The project is now being executed, and thus far there has been secured a channel of the full depth of 27 feet, 1,000 feet wide from the entrance of the harbor to Bug Light, 800 feet wide from Bug Light to the passage between Georges and Gallops islands, and thence 550 feet wide through the Narrows to President Roads.

This survey is directed "with a view to securing a channel 1,200 feet wide and 30 feet deep from the navy-yard to the entrance of the present main ship channel, and from the main ship channel in President Roads through Broad Sound Channel."

Boston Harbor consists, essentially, of an inner and an outer harbor united by a deep waterway, and each accessible from the sea by a distinct channel widening into a deep and spacious roadstead.

The inner harbor lies to the north and westward of Long Island, and has deep water and good anchorage in President Roads, seaward of Lower Middle Bar, and also near the city westward of Upper Middle Bar, the direct entrance to which is by Broad Sound.

The Broad Sound Channel has always been regarded as impracticable for the larger class of vessels, owing to the proximity of dangerous rocks and shoals. It has, therefore, been used only by vessels of light draft, more especially those bound to the eastward; the main ship channel being alone available for the larger class of vessels.

The outer harbor lies to the southward of Long Island, and has a fine anchorage in Nantasket Roads. It connects with the inner harbor by the main ship channel through the Narrows, and its sea entrance is by Boston Light.

The main ship channel of the inner harbor from the navy-yard to President Roads has at present a depth of only 23 feet upon the upper and lower middle bars, and at its narrowest place is 800 feet wide, through which must pass the entire commerce of the harbor of Boston. At the entrance from President Roads this channel is bordered on the north by the dangerous shoal of State Ledge, the dread of the harbor pilots, and upon which was recently wrecked one of the largest trans-Atlantic steamers.

Inadequate anchorage room in the upper harbor is recognized by the work of the State of Massachusetts in enlarging the area of deep water in front of the city wharves.

From President Roads the entrance to the main ship channel through the Narrows is by a sharp turn in the sailing course, and the passage through is attended with great risk and danger on account of its limited width and the congestion of the channel by reason of the great number of vessels frequenting it.

Large vessels occasionally run ashore in the effort to avoid a sailing vessel with the right of way, and the danger of grounding and obstructing the passage is greatly enhanced by reason of the strong cross currents encountered, while the vessel must move under slow speed.

Major Raymond has given the following description of the singular and complicated tidal peculiarities of this channel:

The strongest branch of the ebb sets directly across this channel, passing between Gallops and Georges islands and going out through the Black Rock Channel, between Lovells Island and the Brewster Spit. A portion of this current is deflected by the southeast end of Lovells Island and runs slowly in a northwest direction. Thus we have a strong ebb current running across, a weak one running inward, and no current at all running outward in the main ship channel. But the performances of the flood are still more singular. The strongest current runs through the Black Rock Channel across the Narrows. Just in the very center of the main ship channel it meets a weak current flowing inward from the main entrance, and another which, coming in through Broad Sound and being deflected by Nixs Mate Shoal, flows out-

ward through the main channel. The center of the Narrows is, therefore, the scene of a tumultuous struggle between these three branches of the flood, which, having arranged matters, finally flow out amicably together between Gallops and Georges islands.

Notwithstanding these defects it is well sheltered and convenient.

The insufficiency of present accommodations for the port of Boston has been recognized by Congress in making provision for completing this main ship channel so that it shall have a minimum width of 1,000 feet and a minimum depth of 27 feet, and further providing for this survey and estimate of cost of a channel 1,200 feet wide and 30 feet deep through the main ship channel, and an additional channel of the same dimensions through Broad Sound.

In the progress of improvement of the main ship channel, extending over a period of many years, ledge rock has been encountered in almost every part of it, more especially in the passage between the islands of the lower harbor, and its removal has proved costly. A great deal of rock in place will still have to be removed to complete the channel now being excavated. To enlarge this channel to the contemplated dimensions will, it is estimated, require the removal by dredging of 2,864,079 cubic yards of sand, gravel, and clay, and by drilling and blasting of 40,000 cubic yards of rock, the cost of which appears as follows:

For dredging sand, gravel, and clay, 2,864,079 yards, scow measure, at 25 cents	$716,019.75
For rock excavation, in place, 40,000 yards, at $17.50	700,000.00
	1,416,019.75
Engineering expenses and contingencies, 10 per cent	141,601.97
Total	1,557,621.72

The estimates for the enlarged channel from the navy-yard to President Roads are as follows:

For dredging sand, gravel, and clay, scow measurement, 5,140,196 cubic yards, at 25 cents	$1,285,049.00
For rock excavation, in place, 12,000 yards, at $17.50	210,000.00
	1,495,049.00
Engineering expenses and contingencies, 10 per cent	149,504.90
Total	1,644,553.90

The proximity of the deep water of Broad Sound and President Roads has suggested the possibility of a direct and superior entrance to Boston Upper Harbor, and this survey has confirmed our impression that the channel between them could readily be improved to the dimensions required, and at a small cost compared with the cost of improving the channel through the Narrows. The estimate is as follows:

For dredging 836,082 cubic yards of sand, gravel, and clay, at 35 cents	$292,628.70
For rock excavation, 7,275 yards, at $20	145,500.00
	438,128.70
Engineering expenses and contingencies, 10 per cent	43,812.87
Total	481,941.57

In view of what has already been said, the importance of developing this channel requires no further argument; it is simply a necessity for the large and increasing commerce of the second greatest port on the Atlantic Seaboard. This new channel through Broad Sound would not only relieve the congestion found in the Narrows, but it would probably predominate in importance, from the fact that it would be more direct

and free from complicated tidal disturbances, and be the natural course for the large trans-Atlantic steamers.

A wide, deep channel through Broad Sound, together with the channel through the Narrows, would make the port of Boston unique in that it would have two independent channels nearly at right angles to each other, offering a choice to the navigator in bad weather to and from the commodious and safe anchorage of President Roads.

I am therefore of the opinion that the harbor is worthy of improvement to the extent of providing a channel from the navy-yard to President Roads, and from President Roads through Broad Sound Channel, 1,200 feet wide and 30 feet deep, and the latter should be executed first.

Owing to the difficulties and expense of increasing the dimensions of the lower main ship channel, it is not recommended, as it is thought the improved Broad Sound Channel will amply meet the requirements.

For the details of the survey I would respectfully invite attention to the accompanying very complete and satisfactory report of Assistant Engineer T. T. Hunter Harwood.

Respectfully submitted.

S. M. MANSFIELD,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

REPORT OF MR. T. T. HUNTER HARWOOD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., November 13, 1897.

COLONEL: I have the honor to submit the following report upon a survey of Boston Harbor, Massachusetts, and a project for its improvement, as ordered in section 9, river and harbor act of June 3, 1896, "with a view to securing a channel 1,200 feet wide and 30 feet deep from the navy-yard to the entrance of the present main ship channel, and from the main ship channel in President Roads through Broad Sound Channel;" and also a plan of the harbor, showing locations of the proposed improvement, drawn to a scale of 1:10,000.

SURVEYS.

The limited funds allotted for this work by the Department for surveying purposes in connection with the preparation of the project made it necessary to utilize to the utmost extent such information as was already in the possession of this office.

Surveys of the upper and lower main ship channels dating back to 1888 (the same information as was used in preparation of the project of August 11, 1892), have been utilized in preparing estimates of the cost of improving these channels.

This information, with the knowledge acquired in dredging operations in these channels, was deemed sufficient under the circumstances to base the estimates upon.

BROAD SOUND CHANNEL.

As no information in regard to the Broad Sound Channel had ever been acquired by this office through its own surveys, it was necessary that a close survey of this channel be made.

Operations were commenced on June 24, 1897, and were completed November 13, 1897.

The area covered by the survey was about 1¼ square miles.

Soundings were taken on a system of ranges radiating from Great Faun Bar Beacon, and crossing Broad Sound Channel approximately normal to its axis, at intervals of about 250 feet.

The method adopted for location of soundings was by "the three-point problem," the angles being taken between prominent shore points by two sextant observers in the sounding boat.

A total of 35,058 soundings and 10,773 sextant angles were taken on 143 ranges, aggregating about 150 miles in length.

This work resulted in a satisfactory definition of the Broad Sound Channel and a thorough development of the extensive shoal ground lying between this channel and Great Faun Bar and through which at the commencement of the work it appeared that a channel might advantageously be cut.

The plotting of the notes was kept well along with the field work and early developed the fact that the most economical location of the proposed improvement would be in the Broad Sound Channel. When, therefore, the work of boring was taken up, operations were confined to investigation of the character of the material composing the shoals bordering this channel. Two hundred and twenty-two borings, generally to a depth of at least 30 feet mean low water, were taken on these shoals, and the results show that but little difficulty will be encountered in obtaining 1,200 feet width and 30 feet depth through this channel.

The borings were made by means of a water-jet boring apparatus operated by aid of the steamer *Tourist*, where the depth of material to be penetrated exceeded 5 or 6 feet, and the lighter work was done by means of a sounding pole terminating in a long iron rod.

The surveying operations were under the direct charge of Mr. Thomas J. Finn, United States hydrographer, and were carried on under unusual difficulties, owing to the exposed location of the work and the prevalence of high winds and heavy sea. This is best illustrated by the statement that on thirty-seven of the one hundred and sixteen working days occupied by the survey absolutely no work could be accomplished.

Broad Sound Channel, as developed by the survey, is about 10,000 feet long from the easterly end of the roadstead known as President Roads to deep water in Broad Sound, about west of Commissioners Ledge. It is bordered on the east by flats extending northwest from Lovells Island, by an extensive rocky shoal known as Aldridges Ledge and Devils Back, and by Commissioners Ledge; on the west by continuous shoal ground extending east from Deer Island.

Thirty feet draft of water with a width of about 500 feet can be carried through this channel from President Roads to west of Devils Back, where it is obstructed by a bar with a least width of 300 feet and a greatest depth of 29.8 feet.

In considering the best location of the lines of improvement through the channel, it was evident that excavation on Commissioners Ledge, the Devils Back, and Aldridges Ledge should be avoided as far as possible.

The borings in the shoals west of the channel showed the material to be sand, gravel, clay with bowlders, and in some instances hardpan.

The only indications of ledge found on these shoals were at the southwest end, where either a ledge or a compact bed of large bowlders exists.

The shoal extending northwest from Lovells Island is composed of gravel, clay, and bowlders in places.

All of this material can be readily dredged, and the lines of the improved channel are established with a view to avoiding, as far as possible, ledge excavation. The outer section of the channel is so laid down on the map as to evenly balance between ledge work on the easterly side and dredging from the westerly shoal. At but one point, off the west edge of Aldridges Ledge, is rock excavation proposed, the estimated amount being 2,775 cubic yards.

The axis of this outer section of the channel crosses Lovells Island and renders easy the establishment of a light or range of lights as a guide in its approach.

The axis of the inner section of the channel, if prolonged, would pass through the upper or back range light on Spectacle Island, and leads about midway between Deer and Long Island lights in the deepest part of the entrance to the inner anchorage in President Roads.

No ledge is known to exist in this inner section. At the southwest end of the westerly shoal was located a rocky formation, either of ledge or of bowlders so closely bedded as to be impenetrable with the boring apparatus.

This formation contains about 4,500 cubic yards, and as a matter of precaution should be included in the estimate at the cost of ledge removal.

Estimate of cost of improvement in Broad Sound Channel.

Dredging 836,082 cubic yards of sand, gravel, and clay, at 35 cents per cubic yard	$292,628.70
Removal of 7,275 cubic yards of ledge, at $20 per yard	145,500.00
	438,128.70
Engineering expenses and contingencies, 10 per cent	43,812.87
Total	481,941.57

LOWER MAIN SHIP CHANNEL.

The improvement of this channel to a width of 1,200 feet and depth of 30 feet is a project of great magnitude, because of the contracted passage (the Narrows) between Lovells Island and Georges and Gallops islands, and also because of the large amount of ledge which is known to exist and the certainty of encountering much more ledge in the event of a further widening of the channel.

The proposed channel as laid down upon the map is arranged to include the present 1,000-foot channel of 27 feet depth and passes through the Narrows on lines as economical as the natural obstructions will admit of.

The excavation of this channel would necessitate the removal of 700 feet in length of the eastern end of Gallops Island and about 50,000 square feet in area of the eastern end of Lovells Island, and also makes necessary heavy cutting through the extensive shoal ground off Georges Island.

It is estimated that it will be necessary to excavate 2,904,079 cubic yards of material to carry out this project, of which amount 40,000 cubic yards will be ledge excavation.

Of this ledge estimate 24,292 cubic yards are of ledge already uncovered by the dredging under the project of August 11, 1892, and already reduced to 27 feet at mean low water, and the remainder is a moderate allowance for ledges partly developed by dredging operations on the edge of Georges Island Shoal and the extent of which is as yet undefined.

Estimate of cost of improving the lower main ship channel.

Dredging 2,864,079 cubic yards of sand, gravel, and clay, at 25 cents per yard	$716,019.75
Removal of 40,000 cubic yards of ledge, at $17.50	700,000.00
	1,416,019.75
Engineering expenses and contingencies, 10 per cent	141,601.97
Total	1,557,621.72

UPPER MAIN SHIP CHANNEL.

The lines of the project of improvement for this channel do not essentially differ from those of the channel proposed by the project of August 11, 1892, in their direction, and inclose that channel.

At the entrance to the channel near the Lower Middle the increased width is all on the south side to avoid the removal of "State Ledge," and throughout its length advantage is taken as far as possible of the greatest depth of water.

The estimated amount of excavation necessary to execute this project is 5,152,196 cubic yards, of which 12,000 cubic yards will probably be ledge; this latter estimate being based on the amount of ledge uncovered by dredging the channel to 23 feet at mean low water.

This enormous amount of dredging is caused partly by the increased width of 200 feet, which results alone, in the length of the present upper channel, 27 feet deep, in 1,226,310 cubic yards of dredging, which could be deducted from the estimate if the improvement were confined to the old lines of 1,000 feet width.

Estimate of cost of improving upper main ship channel.

Dredging 5,140,196 cubic yards of mud, sand, gravel, and clay, at 25 cents per cubic yard	$1,285,049.00
Removal of 12,000 cubic yards of ledge, at $17.50 per yard	210,000.00
	1,495,049.00
Engineering expenses and contingencies, 10 per cent	149,504.90
Total	1,644,553.90

In all estimates the number of cubic yards given is for scow measurement.

PLAN.

The basis of the map submitted with this report is a plan which was compiled by the Massachusetts State harbor and land commission in 1895, "from manuscript plans of soundings taken by the United States Coast and Geodetic Survey, 1892–93, corrected and brought up to date by additional information furnished by Col. S. M. Mansfield, Corps of Engineers, U. S. A., and by surveys made under the direction of the harbor and land commissioners."

This plan has been further corrected and brought up to present date, and so far as it was used correctly represents the present condition of the harbor.

Upon it the channel lines were projected after their locations were determined on the survey plans of this office, and the survey of Broad Sound Channel made by this office has been substituted for the hydrography upon the original plan with which it agreed in every essential particular.

This method was adopted to avoid the great labor which would have been necessary to bring the surveys of the office to a common reduced scale sufficiently small to produce a map of reasonable size for publication.

Very respectfully, your obedient servant,

T. T. HUNTER HARWOOD,
Assistant Engineer.

Lieut. Col. S. M. MANSFIELD,
Corps of Engineers, U. S. A.

APPENDIX C.

IMPROVEMENT OF RIVERS AND HARBORS IN SOUTHEASTERN MASSACHUSETTS AND IN RHODE ISLAND.

REPORT OF MAJ. D. W. LOCKWOOD, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1898, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Harbor of refuge at Hyannis, Massachusetts.
2. Harbor of refuge at Nantucket, Massachusetts.
3. Harbor at Vineyard Haven, Massachusetts.
4. Woods Hole Channel, Massachusetts.
5. New Bedford Harbor, Massachusetts.
6. Canapitsit Channel, Massachusetts.
7. Taunton River, Massachusetts.
8. Sakonnet River, Rhode Island.
9. Pawtucket River, Rhode Island.
10. Providence River and Narragansett Bay, Rhode Island.
11. Green Jacket Shoal, Providence, Rhode Island.
12. Wickford Harbor, Rhode Island.
13. Newport Harbor, Rhode Island.
14. Harbor of refuge at Point Judith, Rhode Island.
15. Entrance to Point Judith Pond, Rhode Island.
16. Harbor of refuge at Block Island, Rhode Island.
17. Great Salt Pond, Block Island, Rhode Island.
18. Removing sunken vessels or craft obstructing or endangering navigation.

EXAMINATIONS.

19. Herring River, Harwich, Massachusetts.
20. Salt Pond, Harwich, Massachusetts.

SURVEY.

21. Inner Harbor at Point Judith Pond, Rhode Island.

UNITED STATES ENGINEER OFFICE,
Newport, R. I., July 23, 1898.

GENERAL: I have the honor to transmit herewith annual report on river and harbor works under my charge at close of fiscal year ending June 30, 1898.

The following officers have been on duty under the direction of this office during the year: First Lieut. C. H. McKinstry, Corps of Engineers, from the commencement of the year up to January 23, 1898; First Lieut. Chester Harding, Corps of Engineers, since May 9, 1898; Second Lieut. William B. Ladue, Corps of Engineers, since April 15,

1898, and Second Lieut. William J. Barden, Corps of Engineers, from March 14 to April 15, 1898.

Very respectfully, your obedient servant,

D. W. LOCKWOOD,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

C 1.

HARBOR OF REFUGE AT HYANNIS, MASSACHUSETTS.

The harbor of Hyannis lies on the south shore of the peninsula of Cape Cod, about 15 miles to the westward of the heel of the cape, and is an important harbor of refuge. (For map see page 592, Annual Report of 1884.)

The mean rise and fall of the tide is about 3.75 feet.

Original condition.—Before improvement it was an open roadstead, exposed to southerly storms.

At the adoption of the present project the 15.5 feet depth anchorage area protected by the breakwater covered only about 47 acres.

Present project.—The present project, that of 1884, provides for the deepening to 15.5 feet at mean low water, by dredging, of about 36 additional acres of protected area, to be limited on the west by a line running due north from the western end of the breakwater, and on the north by a line running parallel to the breakwater and 1,500 feet from it, leaving a berm of 100 feet along the northern side of the breakwater, at a cost estimated in 1884 at $45,743.20. A plan of the works may be found at page 560, Annual Report of the Chief of Engineers for 1885, and page 804 of 1893, and further information at page 621 of 1885.

Amount expended and results to June 30, 1896.—In the years 1827–1838 a breakwater of riprap granite, 1,170 feet long, was constructed, covering an anchorage of about 175 acres, the entrance to which had a depth of about 15.5 feet. In the years 1852–1882 extensive repairs were made in increasing the width of its base and the size of the stone forming its size and top. One hundred and twenty-three thousand three hundred and fifty dollars and sixty-two cents was spent on this work. The total amount expended on the present project up to June 30, 1897, was $37,400.02, by which 23 acres of the 36 had been deepened to 15.5 feet, and a contract for about $4,800 worth of dredging was made by the Hartford Dredging Company, of Hartford, Conn., at 21 cents per cubic yard, under date of September 14, 1896.

Operations during the past fiscal year.—The work of dredging under the above contract was commenced September 15 and completed December 9, 1897. Twenty-five thousand eight hundred and three cubic yards of material were excavated, adding about 3.6 acres to the dredged area protected by the breakwater. Under the authority of the Department, dated November 26, two 25-feet-wide cuts were made in the channel leading to the wharf of the New York, New Haven and Hartford Railroad Company. Amount expended, $6,065.51.

This work was in the local charge of Mr. Edward Parrish as assistant engineer, with Messrs. C. O. Abell and Philip S. Spooner as inspectors.

Work required to complete the existing project.—The work still required to complete the existing project is the completion of the dredging to a

depth of 15.5 feet over the remaining 9.4 acres of the proposed anchorage area.

Operations contemplated for the fiscal year ending, June 30, 1899.—It is proposed to apply the balance on hand and the next appropriation toward the completion of the anchorage area inside the breakwater.

Hyannis Harbor is in the Barnstable collection district, and Barnstable is the nearest port of entry. The amount of revenue collected at Barnstable in the last calendar year was $5,671.18. The main value of the harbor is for a harbor of refuge. The nearest light-house is Hyannis Light; the nearest fortification is the fort at Clark Point, New Bedford, Mass.

Money statement.

July 1, 1897, balance unexpended	$6,202.86
June 30, 1898, amount expended during fiscal year	6,065.51
July 1, 1898, balance unexpended	137.35
Amount (estimated) required for completion of existing project	2,162.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	2,162.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

AMOUNTS APPROPRIATED.

Previous projects.

March 2, 1827	$10,650.00	July 11, 1870	$12,000.00
April 30, 1830	6,517.82	March 3, 1871	10,000.00
March 2, 1831	8,400.00	March 3, 1873	10,000.00
July 3, 1832	7,600.00	June 23, 1874	5,000.00
March 2, 1833	5,000.00	June 18, 1878	3,000.00
June 28, 1834	10,000.00	March 3, 1879	2,500.00
March 3, 1835	9,000.00	March 3, 1881	5,000.00
March 3, 1837	5,000.00		
July 7, 1838	8,764.00	Total	123,431.82
August 30, 1852	5,000.00		

Existing project.

August 5, 1886	$10,000.00
August 11, 1888	10,000.00
September 19, 1890	8,000.00
July 13, 1892	6,000.00
August 18, 1894	3,500.00
June 3, 1896	6,000.00
Total	43,500.00
Received from sale of material	20.68
Total	43,520.68

Contract in force.

Contractor.	Date of approval.	To commence.	To complete.
The Hartford Dredging Co.	Oct. 16, 1896	*a* May 1, 1897	Aug. 1, 1897

a Extended to permit of contractor finishing other work.

COMMERCIAL STATISTICS.

The commerce arriving and leaving Hyannis Harbor, Massachusetts, by water during the calendar year ending December 31, 1897, is estimated as follows (based mainly upon reports received from Mr. Thatcher T. Hallett, collector of customs, Barnstable, Mass., and Messrs. T. Crocker & Sons, Hyannis, Mass.):

Class of goods.	1892.	1893.	1894.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Tobacco	.....	.....	5	15	20	10
Rice	.....	.....	2	2	.....	.....
Grains and forage	5,000	4,000	1,000	3,750	1,000	900
Vegetables and truck	30	300	80	1	300	100
Live stock and products	.....	100	134	75	.....	30
Fish, oysters, etc	190	150	195	1,032	200	250
Lumber and products	1,800	200	2,400	2,850	2,500	3,000
Coal, minerals, etc	13,200	30,000	14,500	14,500	18,000	19,500
Fertilizers	.....	50	50	.....	.....	50
General merchandise	450	8,200	270	.....	2,000	1,000
Sundries	200	.....	.....	300	200	180
Total	20,900	43,000	18,636	22,525	24,220	25,020

New transportation companies established during the year, none reported.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
Steam:		*Feet.*	*Tons.*
Freight and passenger	150	10	250
Freight mainly	140	10	100
Passenger mainly	100	10	200
Fishing	25	7	75
Tugs	150	12	200
Pleasure boats	600	11	50
Sail:			
Freight	150	13	250
Fishing boats	300	4	10
Oyster boats	10	3	5
Pleasure boats, large	400	12	175
Pleasure boats, small	600	3	8
Barges	50	14	600

C 2.

HARBOR OF REFUGE AT NANTUCKET, MASSACHUSETTS.

Nantucket Harbor is the only well-protected harbor on Nantucket Sound between the harbors of Marthas Vineyard (Vineyard Haven and Edgartown) and Provincetown, a distance of about 100 miles, except the small harbor of Hyannis, on the other (the north) side of Nantucket Sound. The navigation of this sound is intricate and dangerous by reason of numerous shoals. Nantucket Harbor has a considerable area with a depth of water in excess of 12 feet, and the object of the improvement is to make it a harbor of refuge for vessels plying between ports north and south of Cape Cod, estimated to be 50,000 annually. In the memorial to Congress on which the first appropriation for this harbor of refuge was based it was stated that more than 500 vessels had been wrecked in the vicinity of the island. (For map of harbor see page 423, Annual Report of 1880, and page 576 of Report of 1885.)

The mean rise and fall of the tide is about 3 feet.

Original conditions.—At the adoption of the present project no jetties

existed, and the channel entrance was barred by a shoal of 1.5 miles width on which there was only 6 feet depth of water at low tide, the channel being very crooked and subject to changes in location.

Present project.—The present approved project, that of 1880, as modified in 1885, provides for the construction of two jetties as training walls, one on each side of the harbor entrance, planned so as to allow the tidal current to assist in scouring out and maintaining a good channel, and for the completion of the work by dredging where necessary, to obtain a depth of from 12 to 15 feet at low water in this channel, all at a total cost estimated in 1885 at $375,000.

A plan of the works may be found at page 578, Annual Report of the Chief of Engineers for 1885, and page 806 of 1893; and further information at page 436 of 1880, page 544 of 1881, page 595 of 1884, and pages 563, 575, 578 of 1885.

Amount expended and results to June 30, 1897.—The funds appropriated from 1829 to 1844, $45,734.75, were expended in ineffectual dredging of an entrance channel. The amount expended on the present project up to June 30, 1897, was $217,291.78, by which the west jetty had been built to 4,255 feet length, of which 3,955 feet length was to full height, and 300 feet of partial section, and the jetty strengthened and leveled up at points where it had settled and been somewhat washed down; the east jetty had been built up to its full height for a length of 834 feet from the shore end, then the foundation laid for a length of 191 feet, then came a gap of 160 feet, then 1,300 feet raised to half-tide level, then 2,145 feet raised to 1.5 feet below low-tide level, and the remaining distance of 210 feet (the total length from the shore end being 4,840 feet) raised to 1.5 feet below mean low water, and a mound of heavy stone built to protect a lantern staff near the present end of the jetty.

In December, 1896, during an unusually severe storm, a breach was made between the ocean and the head of the harbor, at what is called the "Haulover." Reports thereon were submitted in January and February, and a more detailed report, after a careful examination of the existing conditions, was submitted in May, 1897.

The breach does not appear to have caused any perceptible change in the depth of water at the harbor entrance, but to avoid narrowing this entrance too much while the breachway was operative, it was deemed advisable to extend the west jetty.

There is now a depth of 8 feet in the channel, which before improvement was limited to 6 feet.

Operations during the past fiscal year.—The amount expended during the past fiscal year was $21,689.98.

The contract for jetty work in progress at the beginning of the fiscal year was completed in September. Nine thousand six hundred and twenty-five tons of stone were placed in the west jetty, extending the same by about 1,000 feet in length, raised to the level of 1.5 feet below mean low water, with mounds every 200 feet extending above high water. The light on this jetty was then moved to the outer end of the new work.

For dimensions of jetty and method of construction see Annual Report of the Chief of Engineers for 1896, Part I, page 627.

In October a contractor who failed to complete his contract in 1895 completed the removal of mooring stones from the channel.

A minor survey of the jetties and jetty channels was made in October and map platted.

A light was maintained near the outer end of each jetty during the year.

This work was in the local charge of Mr. Edward Parrish as assistant engineer, with Mr. Sidney Fisher as inspector.

Work required to complete the existing project.—The work required to complete the existing project is the raising of the incomplete parts of the east jetty, the further extension of both jetties, and the excavation by dredging of so much of the channel as may not be excavated by tidal scour.

Operations contemplated for the fiscal year ending June 30, 1899.—It is proposed to extend the west jetty, if funds are available.

Nantucket is in the Nantucket collection district and is a port of entry. No revenue was collected during the last calendar year. The value of the harbor is mainly as a harbor of refuge. The nearest light-houses are Nantucket Cliff and Brant Point lights. The nearest fortification is the fort at Clark Point, New Bedford, Mass.

Money statement.

July 1, 1897, balance unexpended	$22,708.22
June 30, 1898, amount expended during fiscal year	21,689.98
July 1, 1898, balance unexpended	1,018.24
July 1, 1898, outstanding liabilities	85.65
July 1, 1898, balance available	932.59
Amount (estimated) required for completion of existing project	135,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

AMOUNTS APPROPRIATED.

Previous projects.

May 23, 1828, survey	$300.00	June 14, 1844	$1,169.75
March 2, 1829	30,000.00		
March 2, 1831	8,265.00	Total	45,734.75
July 3, 1832	6,000.00		

Existing project.

July 14, 1880	$50,000.00	September 19, 1890	$25,000.00
March 3, 1881	25,000.00	July 13, 1892	25,000.00
August 2, 1882	25,000.00	August 18, 1894	25,000.00
July 5, 1884	10,000.00	June 3, 1896	20,000.00
August 5, 1886	15,000.00		
August 11, 1888	20,000.00	Total	240,000.00

Contract in force.

Contractor.	Date of approval.	To commence.		To complete.
		At outer end of east jetty.	Balance of work.	
S. & E. S. Belden	Oct. 12, 1896	Oct. 15, 1896	May 15, 1897	Dec. 15, 1897

COMMERCIAL STATISTICS.

The commerce arriving and leaving Nantucket Harbor, Massachusetts, by water during the calendar year ending December 31, 1897, is estimated as follows (based mainly upon reports received by Mr. Arthur B. Enas, collector of customs, and other citizens of Nantucket):

Class of goods.	1892.	1893.	1894.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Tobacco	50	70	.....	40	30	35
Rice	6	60	40	2	3	4
Grains and forage	610	600	650	371	390	400
Vegetables and truck	.....	600	600	415	340	325
Live stock and products	28	15	20	5	6	10
Fish, oysters, etc	70	400	450	500	400	500
Naval stores	.....	10	10	8	3	2
Lumber and products	1,500	1,500	1,500	1,000	1,200	1,400
Coal, minerals, etc	7,000	7,500	8,000	7,000	8,000	10,000
Fertilizers	1,000	600	400	480	16	25
Machinery	150	100	150	30	2,000	1,500
General merchandise	1,500	1,500	1,550	1,560	1,600	2,000
Sundries	1,800	2,000	160	213	500	500
Total	13,709	14,955	13,530	11,624	14,488	16,701

New transportation companies established during the year, none.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
Steam:		*Feet.*	*Tons.*
Freight and passenger	460	7	600
Freight, mainly	25	7	100
Passenger, mainly	100	7	200
Fishing	20	4	5
Tugs	25	5	6
Pleasure boats	50	6	5
Sail:			
Freight	25	7	8
Fishing boats	50	4	5
Pleasure boats, large	100	5	6
Pleasure boats, small	400	4	3

C 3.

IMPROVEMENT OF VINEYARD HAVEN HARBOR, MASSACHUSETTS.

Vineyard Haven is a deep indentation in the northern shore of the island of Marthas Vineyard, on the southern side of Vineyard Sound. It is triangular in form and faces the northeast. The width of the mouth of the harbor, or the distance between the points of land on the east and west sides of the entrance, known as East Chop and West Chop, is about 1.25 miles, and from a line connecting the chops to the narrow southerly end of the harbor, at which is situated the town of Vineyard Haven, the distance is about 1.75 miles. The entire area of the harbor between the shore lines is about 949 acres, of which some 657 acres have a depth of not less than 15 feet. The mean rise and fall of the tide is 1.7 feet.

Original condition.—At the mouth of the harbor the wearing away of the chops by the action of the waves in storms had been noted for many years. The former site of a light-house on West Chop had entirely disappeared. The débris was carried by the current into the harbor, where it formed shoals, which were gradually impairing the anchorage capacity, especially in the upper part of the harbor. (For map of harbor see p. 580 of Annual Report of 1887.)

Plan of improvement.—The present approved project, that of 1887 as modified in 1889, provides for the protection of the chops (or headlands) from erosion and the intervening harbor from being filled by the eroded material, the whole to be done by means of stone sea walls and jetties, to be built along the beach in front of the bluffs at both headlands, all at a total cost estimated in 1889 at $60,000.

A description of the work may be found at page 594, Annual Report of the Chief of Engineers for 1882, page 577 of 1887, and page 612 of 1889, and a map of the same at page 812 of 1893.

Amount expended and results to June 30, 1897.—The amount expended to June 30, 1897, was $42,833.30, by which there had been built a sea wall 960 feet long, a jetty 50 feet long, and 5 small spurs extending back from the sea wall to the foot of the bluff on the East Chop; a sea wall 880 feet long and 3 jetties, 150, 135, and 280 feet long, a wharf and a short stone breakwater 60 feet in length, near the end of the wharf on the West Chop, and 270 feet length of riprap wall along the low-water line in front of the bluff on the east side of the West Chop.

Operations during the past fiscal year.—The amount expended during the past fiscal year was $10,697.96.

At the commencement of the fiscal year the work of constructing riprap walls and jetties was in progress under contract with Mr. William S. White, of Rockland, Me., at $1.95 per ton of stone in position. All work under the contract was completed on September 30, 1897. Four thousand nine hundred and seventy-four tons of stone were placed, by which 2,130 feet (making 2,400 feet in all) of riprap wall were constructed along the low-water line in front of the bluff on the east side of the West Chop, and 13 short jetties running in from the sea wall to the foot of the bluff; and on the East Chop 250 feet of sea wall were constructed, together with 1 jetty running into the foot of the bluff, completing all proposed work.

For dimensions of walls and details of construction see Annual Report of Chief of Engineers for 1896, Part I, page 632.

This work was in the local charge of Mr. Edward Parrish as assistant engineer, with Mr. Arthur J. Ober as inspector.

Work required to complete the existing project.—No further work required.

Vineyard Haven is in the Edgartown collection district. Edgartown is the nearest port of entry. The amount of revenue collected at Edgartown in the last calendar year was $782.12. The nearest light-houses are those on East and West Chops. The nearest fortification is the fort at Clark Point, New Bedford, Mass.

Money statement.

July 1, 1897, balance unexpended	$14,166.70
June 30, 1898, amount expended during fiscal year	10,697.96
July 1, 1898, balance unexpended	3,468.74

AMOUNTS APPROPRIATED.

Existing project.

August 11, 1888	$25,000
September 19, 1890	10,000
July 13, 1892	7,500
August 18, 1894	7,500
June 3, 1896	7,000
Total	57,000

Contract in force.

Contractor.	Date of approval.	To commence.	To complete.
Wm. S. White	Apr. 22, 1897	May 1, 1897	Nov. 1, 1897

COMMERCIAL STATISTICS.

The commerce arriving at and leaving Vineyard Haven Harbor, Massachusetts, by water during the calendar year ending December 31, 1897, is estimated as follows (based mainly upon reports received from Mr. H. B. Dick, Weather Bureau Service, Vineyard Haven, Mass.):

Class of goods.	1892.	1893.	1894.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Cotton and products	20	20	40	35	60	50
Tobacco	15	15	15	16	5	7
Rice	45	45	45	50	50	30
Grain and forage	2,500	2,500	800	1,100	2,000	2,000
Vegetables and truck	15	15	15	30	30	30
Live stock and products	200	200	200	150	200	150
Fish, oysters, etc	500	500	500	700	1,500	1,500
Naval stores	.....	.....	60	10	20	15
Lumber and products	2,500	2,500	350	900	3,000	10,000
Coal, minerals, etc	8,000	8,000	52,000	47,000	48,000	50,000
Fertilizers	50	50	50	40	100	75
Machinery	100	100	.....	50	50	55
General merchandise	5,000	5,000	5,000	8,500	6,000	7,450
Sundries	1,500	1,500	.....	.....	1,500	1,500
Total	20,445	20,445	59,075	58,581	62,515	73,862

New transportation companies established during the year, none.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
Steam:		*Feet.*	*Tons.*
Freight and passenger	800	6	150
Freight mainly	200	10	250
passenger mainly	50	6	150
Fishing	75	11	160
Tugs	400	12	110
Pleasure boats	600	9	90
Sail:			
Freight	6,000	12	600
Fishing boats	400	9	100
Oyster boats	12	5	20
Pleasure boats, large	400	12	100
Pleasure boats, small	300	4	15
Barges	1,200	15	1,200

C 4.

IMPROVEMENT OF WOODS HOLE CHANNEL, MASSACHUSETTS.

This harbor is on the north side of Vineyard Sound, and is divided into Great Harbor and Little Harbor. The name of Woods Hole is also applied to the adjoining strait or channel which connects the waters of Buzzards Bay with Vineyard Sound and separates the chain of islands known as the Elizabeth Islands from the southwestern extremity of the peninsula of Cape Cod.

Original condition.—Before improvement the entrance to Little Harbor was obstructed by a bar with but 7.5 feet of water on it at mean

low water. Great Harbor has ample depth. The site of the wharves and basins of the United States Fish Commission and Revenue Marine was a submerged point of land extending from the shore of the harbor. In the strait the channels were crooked and obstructed by numerous bowlders, and the velocity of the currents at certain stages of the tide was from 4 to 5 miles per hour.

Plans of improvement.—The project of 1879 provided for making a channel through the bar at the entrance to Little Harbor and widening and deepening the channel in the strait. The project of 1883, extended in 1884 and 1886, provided for the construction of a retaining wall on the shore, a hollow pier and wharves for the use of the United States Fish Commission, and to serve also as a coaling station for vessels of the Revenue Marine and other branches of the public service, and as a harbor of refuge, all of which was completed in 1888. In the project of 1895, which is the present approved project, it is proposed to give the channel through the strait and its southeastern branch a width of 300 feet and a low-water depth of 13 feet, at an estimated cost of $396,000.

Amounts expended and results up to June 30, 1897.—The amount expended up to June 30, 1897, was $113,621.91. The first appropriation, that of 1852, had been expended in building a breakwater, which proved beneficial by arresting an influx of sand into Great Harbor. With the appropriation of 1879 the depth of water at entrance to Little Harbor had been increased from 7.5 to 10 feet, and a direct channel made 120 feet wide and 9 feet deep through the strait, benefiting greatly the commerce of Buzzards Bay. The wharves and piers had been completed in 1888, and a breach made in the east pier wall by storms and the wharves had been repaired in 1895. A survey of the strait and Little Harbor had been made, and report with project and estimate for further improvement was submitted August 17, 1895. (See p. 750 and p. 72, Annual Report Chief of Engineers, 1895.) A contract for about $18,000 worth of dredging and removing bowlders had been entered into with Mr. Charles W. Johnston, of Philadelphia, Pa., under date of April 12, 1897, at $7.75 per cubic yard.

Operations during the past fiscal year.—The amount expended during the past fiscal year was $19,955.50. Owing to the large amount of summer travel through the narrow channel to be improved, the contractor did not commence work until the 4th of December. Between that date and the 27th of the same month two cuts, each 35 feet in width and 13 feet in depth, were dredged through the shoal at the eastern entrance to the channel, 2,450.68 cubic yards of sand and bowlders being removed.

This work was in the local charge of Mr. Edward Parrish as assistant engineer, with Mr. Arthur J. Ober as inspector.

Work required to complete the existing project.—The work required to complete the existing project is the widening and deepening the channel through the strait.

Operations contemplated for the fiscal year ending June 30, 1899.—It is proposed to expend the available funds in widening and deepening the channel through the strait.

Woods Hole is in the Barnstable collection district. New Bedford is the nearest port of entry. The amount of revenue collected in the last calendar year was, at Barnstable, $5,671.18, and at New Bedford, $2,389.51. The nearest light-house is Nobska Light. The nearest fortification is the fort at Clark Point, New Bedford, Mass.

Money statement.

July 1, 1897, balance unexpended	$19,978.01
June 30, 1898, amount expended during fiscal year	19,955.50
July 1, 1898, balance unexpended	22.51
Amount (estimated) required for completion of existing project	376,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	150,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

AMOUNTS APPROPRIATED.

August 10, 1852	$2,500.00
March 3, 1879	15,000.00
August 2, 1882	52,000.00
July 5, 1884	25,000.00
August 5, 1886	14,500.00
March 2, 1895	5,000.00
June 3, 1896	20,000.00
Total	134,000.00
December 5, 1895, unexpended balance deposited to the credit of the United States Treasurer	400.08
Total	133,599.92

Contract in force.

Contractor.	Date of approval.	To commence.	To complete.
Charles W. Johnston	May 8, 1897	a May 1, 1897	Dec. 31, 1897

a Extended to September, 1897.

COMMERCIAL STATISTICS.

The commerce arriving and leaving Woods Hole, Mass., by water during the calendar year ending December 31, 1897, is estimated as follows (based mainly upon reports received from Mr. Walter D. Luscombe, of Woods Hole, Mass.):

Class of goods.	1894.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*	*Tons.*
Grains and forage	2,275	2,265	3,000	3,500
Vegetables and truck	4	8	9	15
Live stock and products	123	150	150	170
Fish, oysters, etc	158	225	200	210
Naval stores	5	5	15	28
Lumber and products	2,170	4,000	3,900	4,000
Coal, minerals, and products	2,025	4,000	5,000	5,500
Fertilizers	100	50	75	200
General merchandise	1,115	1,082	1,200	1,200
Total	7,975	11,785	13,549	14,823

New transportation companies established during the year, none.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
Steam:		*Feet.*	*Tons.*
Freight and passenger	400	10	900
Freight, mainly	100	7	20
Passenger, mainly	200	11	50
Fishing	50	8	30
Tugs	40	10	350
Pleasure boats	100	10	100
Sail:			
Freight	50	8	150
Fishing boats	100	8	50
Pleasure boats, large	35	4	15
Pleasure boats, small	200	3	5

C 5.

IMPROVEMENT OF NEW BEDFORD HARBOR, MASSACHUSETTS.

New Bedford Harbor is an estuary of Buzzards Bay and is the port of the cities of New Bedford and Fairhaven, Mass. New Bedford is an important port of entry. It is largely interested in manufactures, those of cotton predominating, and has an extensive commerce in addition to its whale fisheries. The population of New Bedford and Fairhaven in 1890 was about 45,000.

The mean rise and fall of the tide is about 4.2 feet.

Original condition.—Before improvement the channel had a ruling depth of about 12.5 feet at mean low water.

At the adoption of the present project the channel was winding and about 15 feet deep.

Plan of improvement.—The project of 1887, which provided for a channel 200 feet wide and 18 feet deep at mean low water from Buzzards Bay to New Bedford, at an estimated cost of $35,000, has been practically completed. The present approved project, that of 1895, provides for dredging an anchorage area one-half mile long, 600 feet wide, and 18 feet deep at mean low water on the north side of the channel leading from New Bedford to Fairhaven.

A description of the works may be found at page 514, Annual Report of the Chief of Engineers for 1888, and a plan of the same in House Ex. Doc. No. 86, Fiftieth Congress, first session, and at page 816, Annual Report for 1893; also at page 672, Annual Report for 1896, and in House Ex. Doc. No. 59, Fifty-fourth Congress, first session.

Amount expended and results up to June 30, 1897.—The total amount expended to June 30, 1897, was $80,643.08, of which $17,691.37 had been expended in 1836–1839 in removing a wreck and dredging the sand bar which had been formed by it; $20,000 had been expended in 1875 to 1877 in completing a channel 300 feet wide and 15 feet deep from the deep water above Palmers Island to the wharves of New Bedford, and $42,951.71 since 1888 in deepening the channel to 18 feet at mean low water for a width of 200 feet from the wharves in New Bedford to the deep water of Buzzards Bay, and in adding 11 acres, by dredging, to the 18-foot anchorage area in the upper harbor.

Operations during the past fiscal year.—The amount expended during the past fiscal year was $4,001.71.

No operations were in progress during the year, and at the date of

this report the improved channel and anchorage areas are in good condition. Further dredging awaits further appropriations.

New Bedford Harbor is in the New Bedford collection district, and is a port of entry. The amount of revenue collected in the last calendar year was $2,389.51. The nearest light-houses are Clark Point Light and the lights in New Bedford Harbor. The nearest fortification is fort at Clark Point, Massachusetts.

Money statement.

July 1, 1897, balance unexpended	$2,057.29
June 30, 1898, amount expended during fiscal year	1,944.42
July 1, 1898, balance unexpended	112.87
Amount (estimated) required for completion of existing project	47,689.33
Amount that can be profitably expended in fiscal year ending June 30, 1900	47,689.33
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

AMOUNTS APPROPRIATED.

July 4, 1836	$10,000.00
July 7, 1838	7,691.37
March 3, 1875	10,000.00
August 14, 1876	10,000.00
August 11, 1888	10,000.00
September 19, 1890	10,000.00
July 13, 1892	7,500.00
August 18, 1894	7,500.00
June 3, 1896	10,000.00
Total	82,691.37
Received from sale of material	9.00
Total	82,700.37

COMMERCIAL STATISTICS.

The commerce arriving and leaving New Bedford, Mass., by water during the calendar years 1893–1897 is estimated as follows (based mainly upon reports received from Mr. Z. W. Pease, collector of customs, New Bedford, Mass.):

Class of goods.	1893.	1894.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Cotton and products	13,500	10,500	9,036	22,400	15,000
Tobacco	5	14	28	50	40
Grains and forage	21,000	24,400	30,470	15,000	20,000
Vegetables and truck	650	2,630	2,920	7,100	5,000
Live stock and products	200	100	160	500	400
Fish, oysters, etc	5,500	2,378	1,783	3,250	2,500
Naval stores	.....	1,275	1,275	.....	25
Lumber and products	2,500	21,400	22,500	33,500	35,000
Coal, minerals, and products	450,000	459,000	517,375	650,000	500,000
Fertilizers	.....	.....	60	150	200
General merchandise	103,000	59,515	62,160	100,000	75,000
Sundries	33,000	.....	11,656	10,000	15,000
Total	629,355	581,212	659,423	841,950	668,165

New transportation companies established during the year, none reported.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one:

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight and passenger	700	8	500
Freight mainly	400	17	1,000
Passenger mainly	500	8	60
Tugs	500	8	50
Pleasure boats	250	8	50
Sail:			
Freight	1,000	13	1,100
Fishing boats	550	5	10
Pleasure boats, large	400	9	40
Pleasure boats, small	1,000	5	10
Barges	350	13	1,000

C 6.

IMPROVEMENT OF CANAPITSIT CHANNEL, MASSACHUSETTS.

This waterway lies about 20 miles south of New Bedford, running between the islands of Cuttyhunk and Nashawena, Massachusetts, and connecting the waters of Vineyard Sound and Buzzards Bay.

The object of the improvement is to make this channel safe for the use of light-draft sailboats, and also especially of the surf boats belonging to the life-saving station of this dangerous locality.

Original condition.—Before improvement the sand shoals and numerous bowlders made this passage specially dangerous to the life-saving station boats and other shallow-draft row and sail boats.

Plan of improvement.—The present approved project, that of 1891, provides for the widening and deepening of the present channel from Vineyard Sound to Buzzards Bay, so as to secure a depth of 6 feet at low water, with a least width of 150 feet over its entire length, all at a total cost estimated in 1893 of $9,800.

A description of the work may be found at page 645, Annual Report of the Chief of Engineers for 1892, and a plan of the same in House Ex. Doc. No. 59, Fifty-second Congress, first session, and at page 820 of Annual Report for 1893; and further special information on page 820, Annual Report for 1893.

Amount expended and results to June 30, 1897.—The amount expended up to June 30, 1897, was $5,236.04, by which a channel of 66 feet width and about 5 feet depth at low water, was cut entirely through from Buzzards Bay to Vineyard Sound, and a contract for about $3,500 worth of work was entered into with the Hartford Dredging Company, of Hartford, Conn., under date of April 13, 1895, at 36 cents per cubic yard, but they had only removed 162 cubic yards of material at the close of the year. The work heretofore has been done by hired labor and the use of the Government plant, the method adopted being to loosen the very compact material of the bottom with dynamite, and then remove it with a clam-shell dredge, at the time belonging to the Government.

Operations during the past fiscal year.—The contract for dredging work, in progress at the beginning of the fiscal year, was continued until September 4, 1897, when work was suspended, all material being removed that could be removed by the dredge employed. The remaining work was finally completed in June, 1898. During the year 5,638 cubic yards of sand, gravel, and small bowlders, and 89.108 cubic yards of large

bowlders were removed from the channel, completing the channel to its full dimensions.

Work required to complete the existing project.—The project is completed.

Operations contemplated for the fiscal year ending June 30, 1899.—No further work proposed.

Canapitsit Channel is in the New Bedford collection district. New Bedford is the nearest port of entry. The amount of revenue collected at New Bedford in the last calendar year was $2,389.51. The nearest light-houses are the Cuttyhunk and Gay Head light-houses. The nearest fortification is fort at Clark Point, Massachusetts.

Money statement.

July 1, 1897, balance unexpended	$4,563.96
June 30, 1898, amount expended during fiscal year	2,529.00
July 1, 1898, balance unexpended	2,034.96
July 1, 1898, outstanding liabilities	1,152.55
July 1, 1898, balance available	882.41

AMOUNTS APPROPRIATED.

July 13, 1892	$4,800
August 18, 1894	5,000
Total	9,800

Contract in force.

Contractor.	Date of approval.	To commence.	To complete.
The Hartford Dredging Co	Apr. 30, 1895	*a* June 1, 1895	*b* Sept. 1, 1896

a Extended to March 15, 1897. *b* Extended to June 30, 1898.

COMMERCIAL STATISTICS.

The commerce arriving and leaving Cuttyhunk, Mass., by water during the calendar years ending December 31, 1892–1897, is estimated as follows (based mainly upon reports received from Mr. D. P. Bosworth, Cuttyhunk, Mass.):

Class of goods.	1892.	1893.	1894.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Cotton and products		1			2	4
Tobacco	1	2	1	2	3	5
Grains and forage	16	25	47	57	100	110
Vegetables and truck	3	4	10	14	18	20
Live stock and products	4	10	136	140	140	150
Fish, oysters, etc	180	250	1,000	1,100	2,000	2,000
Naval stores	2	2	2.5	3	3	3
Lumber and products	40	70	102	150	100	200
Coal, minerals, etc	350	50	50	100	150	200
Fertilizers		2	5	5	5	8
Machinery		2				3
General merchandise	20	250	193	200	250	250
Sundries	70	40	87	100	150	175
Total	700	708	1,633.5	1,871	2,921	3,128

New transportation companies established during the year, none reported.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight and passengers	195	6	60
Fishing	20	9	125
Tugs	30	9	80
Pleasure boats	100	5	20
Sail:			
Freight	75	4	11
Fishing boats	1,700	4	5
Pleasure boats, large	150	8	80
Pleasure boats, small	300	3	4

C 7.

IMPROVEMENT OF TAUNTON RIVER, MASSACHUSETTS.

This river rises in Norfolk County, Mass., and empties in Mount Hope Bay, a part of Narragansett Bay. It is about 44 miles in length.

The object of the improvement is to deepen and widen the channel so that vessels of 11 feet draft can at high water go up to the city of Taunton, which for its extensive manufactures requires large quantities of coal, iron, clay, molding sand, and other heavy articles. The rise and fall of the tide before improvement was 5.25 feet at Dighton and 3.4 feet at Taunton.

Original condition.—In its original condition the channel was narrow and obstructed by bowlders, and from Berkley Bridge to Taunton its depth was not, in places, more than 5 feet at mean high water. A vessel of 30 tons burden was as large as could go up to Taunton.

At the adoption of the present project the channel was limited to 9 feet at high water, and was too narrow and too much obstructed by bowlders for easy navigation by the craft making use of it.

Plan of improvement.—The present approved project, that of 1880, provides for the widening and deepening of the river so as to secure a channel of at least 12 feet depth at high water, with 100 feet width from its mouth up to Berkley Bridge (above Dighton); thence 12 feet depth with 80 feet width (100 feet width at bends) up to Briggs Shoal; thence 11 feet depth with the same width up to the shipyard; thence 11 feet depth with 60 feet width up to the Weir Bridge, Taunton; all at a total cost estimated in 1893 at $125,000.

A plan of the works may be found at page 606, Annual Report of the Chief of Engineers for 1884, and page 824 of the Annual Report for 1893; and a later more detailed plan in House Ex. Doc. No. 86, Fiftieth Congress, first session; and further information at page 373 of the Annual Report for 1880, page 519 of the Annual Report for 1888, and page 823 of the Annual Report for 1893.

Amount expended and results to June 30, 1897.—The total amount expended up to June 30, 1897, was $180,510.11. The $63,000 appropriated from 1870 to 1879 secured a depth of 9 feet at high water up to the head of navigation. (See p. 375, Annual Report for 1880.) By the expenditure of the subsequent appropriations the proposed work had been practically completed, so that there was a fairly good channel with a minimum depth of 11 feet at high water from the head of navigation to Narragansett Bay, which, however, needed widening at a few points at and below the lower end of the "Needles."

Operations during the past fiscal year.—No work done and no funds expended during the past fiscal year. Further work awaits further appropriations.

Work required to complete the existing project.—There remains to complete the existing project the widening and deepening of the channel at the lower end of the "Needles" and at a few points below, and the removal of a small amount of ledge rock.

Operations contemplated for the fiscal year ending June 30, 1899.—It is proposed to continue the widening and deepening of the channel at the narrow and shoal places.

Taunton River is in the Fall River collection district. Fall River is the nearest port of entry. The amount of revenue collected at Fall River in the last calendar year was $18,400.67. The nearest light-house is the Borden Flat Light-House. The nearest fortification is Fort Adams, Newport Harbor, Rhode Island.

Money statement.

July 1, 1897, balance unexpended	$489.89
July 1, 1898, balance unexpended	489.89
Amount (estimated) required for completion of existing project	7,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	7,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

AMOUNTS APPROPRIATED.

Previous projects.

July 11, 1870	$10,000	March 3, 1875	$10,000
March 3, 1871	10,000	June 18, 1878	2,000
June 10, 1872	10,000	March 3, 1879	1,000
March 3, 1873	10,000		
June 23, 1874	10,000	Total	63,000

Present project.

July 14, 1880	$17,500	July 13, 1892	$7,000
March 3, 1881	25,000	August 18, 1894	5,000
August 2, 1882	25,000	June 3, 1896	5,000
July 5, 1884	26,500		
September 19, 1890	7,000	Total	118,000

Efforts were made to obtain a statement of the commerce of the river for the year ending December 31, 1897, but without success. For commerce of the previous six years see Annual Report for 1897.

C 8.

IMPROVEMENT OF SAKONNET RIVER, RHODE ISLAND.

The Sakonnet River is an arm of the sea between the island of Rhode Island and the mainland, extending from the ocean to Narragansett Bay around the head of Rhode Island. The entrance from the ocean is unobstructed, and formerly the entire river from Narragansett Bay to the ocean was navigable for the largest ships.

At present the upper end of the river is obstructed by two bridges or causeways, the northern one belonging to the New York, New Haven and Hartford Railroad Company and the other owned by the State of Rhode Island. These causeways have draws of insufficient capacity, and the approved project of July, 1896, proposed to increase the width and depth of the draw opening through the causeway owned by the State from 35 feet, present width, to 100 feet; and from 9 feet, present depth, to 25 feet at mean low water.

For fuller description of the subject, see report of the Chief of Engineers for 1895, pages 729 to 737.

No work has been done and no funds expended during the past fiscal year, owing to the fact that the State assembly's permission to the United States to widen and deepen the draw opening in its bridge is conditioned in such a way as to make it inoperative until the railroad company shall have widened and deepened the draw opening of its bridge.

Notice was received in May, 1898, that the New York, New Haven and Hartford Railroad Company had been ordered by the Secretary of War to construct a suitable draw in its bridge by May 1, 1899.

Sakonnet River is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last calendar year was $2,015. The nearest light-houses are Muscle Bed Shoals, Bristol Ferry, and Warwick light-houses. The nearest fortification is Fort Adams, R. I.

Money statement.

July 1, 1897, balance unexpended	$20,000.00
July 1, 1898, balance unexpended	20,000.00
Amount (estimated) required for completion of existing project	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	20,000.00

Submitted in compliance with requiremets of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

COMMERCIAL STATISTICS.

The commerce arriving and leaving Sakonnet River, Rhode Island, by water during the calendar years ending December 31, 1896–1897, is estimated as follows (based mainly upon reports received from Mr. J. A. Pettey, general manager of the Sakonnet Steamboat Company):

Class of goods.	1896.	1897.
	Tons.	*Tons.*
Tobacco	.....	3
Rice	.....	2
Grains and forage	2,100	2,500
Vegetables and truck	10	50
Live stock and products	25	40
Fish, oysters, etc	200	300
Lumber and products	350	430
Coal, minerals, etc	650	750
Fertilizers	5	45
Machinery	5	10
General merchandise	300	400
Sundries	15	25
Total	3,660	4,555

New transportation companies established during the year, none.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
Steam:		*Feet.*	*Tons.*
Freight and passenger	300	7½	100
Passenger mainly	100	6	100
Fishing	200	6.5	80
Tugs	10	7	90
Pleasure boats	15	7	100
Sail:			
Fishing boats	200	3	4
Pleasure boats, large	4	8	80
Pleasure boats, small	300	3	2

C 9.

IMPROVEMENT OF PAWTUCKET RIVER, RHODE ISLAND.

The navigable part of the Pawtucket (or Seekonk) River, an arm of Providence River, extends from Providence to Pawtucket, a city which in 1890 had a population of about 28,000 and extensive manufactures, depending largely on water transportation. The mean rise and fall of the tide is about 5 feet.

Original condition.—Before improvement the channel in the river was narrow and had a ruling depth of about 5 feet at mean low water.

At the adoption of the present project the channel was narrow and only about 7 feet deep.

Plan of improvement.—The present improved project, that of 1883, provides for the deepening of the river so as to secure a channel of at least 12 feet depth at low water with 100 feet width from its mouth at Providence up to opposite Grant & Co.'s wharf, at Pawtucket, and thence 12 feet depth with 40 feet width through a stone ledge for a short distance toward Division Street Bridge; all at a total cost estimated in 1883 at $382,500.

A plan of the works may be found at page 608, Annual Report of the Chief of Engineers for 1884, and page 830 of 1893, and further description at page 677 of 1895.

Amount expended and results to June 30, 1897.—The total amount expended up to June 30, 1897, was $253,948.39.

The $52,000 appropriated between 1867 and 1882 had dredged the channel to 75 feet width and 7 feet depth at low water. This work was completed in 1876.

The expenditure of subsequent appropriations had dredged the channel to 100 feet width and 12 feet depth as far as projected, and removed about two-thirds of the ledge from the channel 40 feet wide and 12 feet deep in front of the wharves at Pawtucket, and also completed the lower section of the channel through the ledge rock to its full dimensions of 40 feet width and 12 feet depth at mean low water. A contract for removing about 1,300 cubic yards of ledge rock under the 1896 appropriation was entered into on April 14, 1897, with John J. Fitzpatrick, of Plattsburg, N. Y., at $6.66 per cubic yard. Under the provisions of this contract work was commenced in April, 1897, and was in progress at the close of the fiscal year. Drilling and blasting had been carried on over about one-half of the upper section of the channel, but no rock had been removed. A small amount of dredging had also been done between the piers of Central or Red Bridge, near the lower

end of the improved channel, while the city of Providence was rebuilding the bridge, making the water there 20 feet deep and largely increasing the waterway through it.

The main channel has somewhat filled up near its banks.

Operations during the past fiscal year.—The amount expended during the past fiscal year was $12,443.03.

At the beginning of the fiscal year work under the above-described contract then in progress was continued, and completed in October, 1897. Seven hundred and fifty-three holes were drilled and blasted in the ledge rock of the upper reach, and 1,643.9 cubic yards of broken stone were removed, resulting in the completion of the channel through the ledge rock to its full dimensions of 40 feet width and 12 feet depth at mean low water.

This work was under the local charge of Mr. Edward Parrish as assistant engineer, with Mr. John F. Parks as inspector.

Work required to complete the existing project.—The work yet to be done is to straighten the channel in the lower part of the river and to deepen it at points where it has shoaled.

Operations contemplated for the fiscal year ending June 30, 1899.—It is proposed to apply the balance of the funds on hand toward the straightening and deepening of the channel in its lower portions.

Pawtucket is in the collection district of Providence, and that port is the nearest port of entry. The amount of revenue collected in Providence in the last calendar year was $198,734.22. The nearest light-house is Sassafras Point Light. The nearest fortifications are Fort Adams, Newport, R. I., and the fort on Dutch Island, Rhode Island.

Money statement.

July 1, 1897, balance unexpended	$23,571.20
June 30, 1898, amount expended during fiscal year	12,443.03
July 1, 1898, balance unexpended	11,128.17
Amount (estimated) required for completion of existing project	30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

AMOUNTS APPROPRIATED.

March 2, 1867	$17,000.00	July 13, 1892	$35,000.00
July 11, 1870	8,000.00	August 18, 1894	25,000.00
March 3, 1871	7,000.00	June 3, 1896	20,500.00
June 10, 1872	10,000.00	Total	277,500.00
March 3, 1873	10,000.00	Received from sale of material	19.59
July 5, 1884	50,000.00		
August 5, 1886	30,000.00	Total	277,519.59
August 11, 1888	35,000.00		
September 19, 1890	30,000.00		

Contract in force.

Contractor.	Date of approval.	To commence.	To complete.
John J. Fitzpatrick	May 22, 1897	May 1, 1897	Oct. 1, 1897

COMMERCIAL STATISTICS.

The commerce arriving and leaving Pawtucket River, Rhode Island, by water during the calendar years ending December 31, 1893–1897, is estimated as follows (based mainly upon reports received from the Newell Coal and Lumber Company, of Pawtucket, R. I.):

Class of goods.	1893.	1894.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Cotton and products	700	.....	.....	.....	.....
Lumber and products	14,500	12,600	8,620	9,000	9,000
Coal, minerals, etc	168,000	158,000	175,447	175,000	175,000
Fertilizers	1,433	7,000	1,099	1,000	1,000
General merchandise	.....	5,850	10,308	11,500	10,000
Sundries	2,000	.....	.....	5,000	5,000
Total	186,633	183,450	195,474	201,500	200,000

New transportation companies established during the year, none reported.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight, mainly	250	10	500
Passenger, mainly	275	8	100
Tugs	500	7	80
Miscellaneous	125	5	50
Sail:			
Freight	175	10	300
Pleasure boats, large	20	7	100
Pleasure boats, small	300	3	4
Barges	100	10	500

C 10.

IMPROVEMENT OF PROVIDENCE RIVER AND NARRAGANSETT BAY, RHODE ISLAND.

Providence River is an estuary of Narragansett Bay. The object of its improvement is to furnish a wide and deep channel for European and coastwise commerce from the ocean to Providence, a city which had in 1890 about 132,000 inhabitants, being twenty-fifth in size of the cities of the United States, a city largely engaged in manufactures, and also a port of entry for an extensive region of country with which it is connected by railroads. The mean rise and fall of the tide is 4.7 feet.

Original condition.—Before the improvement of the river was commenced in 1853 many shoals obstructed navigation, and at one point in the channel, a place called The Crook, the available low-water depth was but 4.5 feet.

Plans of improvement.—The projects between 1852 and 1873 provided for deepening the channel by removing obstructing rocks and dredging at the shoalest points to secure first a depth of 9 feet and then 12 feet. This work was completed in 1878. The project of 1878 as modified in 1882 provided for a channel 300 feet wide and 25 feet deep from Providence to the deep water of Narragansett Bay and for an anchorage basin between Fox Point and Fields Point, with a depth of 20 feet 600 feet wide, a depth of 18 feet 725 feet wide, a depth of 12 feet 940 feet wide, and a depth of 6 feet 1,060 feet wide; all at a total estimated cost in 1882 of $675,000. The 25-foot channel of this project has been laid out in straight reaches (with enlargements at the angles), with a view to their being lighted later, if it should be found necessary, by range or

leading lights, such as are used in similar cases in Chesapeake Bay, Delaware River, and other localities.

The river and harbor act of June 3, 1896, provides for securing a ship channel 400 feet in width and of a depth of 25 feet at mean low water from Sassafras Point, in Providence Harbor, through Providence River and Narragansett Bay, by the most direct route practicable to the ocean by way of the "Western Passage," so called, at an estimated cost of $732,820.

A project for this new work from Sassafras Point to Conimicut Point was approved August, 1896.

A plan of the old works may be found at page 622, Annual Report of the Chief of Engineers for 1884, page 830 of 1893, and further special information at page 235 of 1878, and page 557 of 1882.

Amount expended and results to June 30, 1897.—The amount expended up to June 30, 1897, was $698,490.60, by which a channel 300 feet wide and 25 feet deep had been secured up to the city of Providence, Bulkhead Rock had been removed, and an anchorage area 1,060 feet wide, with depths varying from 6 to 20 feet, had been dredged between Fields Point and Fox Point; but both the channel and anchorage area have shoaled considerably in places and need some redredging.

A survey of the river between Sassafras and Conimicut points was made in October, 1896, for securing data for dredging under the appropriation of 1896.

A continuous contract was entered into on February 26, 1897, with Mr. P. Sanford Ross, of Jersey City, N. J., at 8⅞ cents per cubic yard, for removing about 1,122,000 cubic yards of material between those points. Under this agreement the dredge had covered about one-third of the distance between Fields Point and Pomham below the former place, leaving the channel from there to Conimicut Point to be completed.

Operations during the past fiscal year.—The amount expended during the past fiscal year was $73,128.78.

The work of dredging the new ship channel under the continuous contract with Mr. P. Sanford Ross was continued throughout the year, and 745,655 cubic yards of material were removed, practically completing the channel between Sassafras Point and Pomham light-house and completing the removal of about one-half of the material from the reach between Pomham and Sabines light-houses.

In compliance with Department instructions, a preliminary project for extending the improvement of the "Western Passage" below Conimicut Point was submitted in January and approved in February, 1898.

A survey of the river below Conimicut Point was made during March and April, 1898, for securing data for the extended improvement, and this work is now being platted.

This work was under the local charge of Mr. Edward Parrish as assistant engineer, with Messrs. T. W. Kennan, C. O. Abell, John F. Parks, Philip S. Knauer, and Hugh D. Rose as inspectors. The survey was under the charge of Mr. C. M. Winchell, assistant engineer.

Operations contemplated for the fiscal year ending June 30, 1899.—It is proposed to continue the work of dredging in the new ship channel and make the necessary arrangements for continuing the excavation down through the Western Passage. When the platting of the survey mentioned above is completed, a detailed estimate of the work required below Conimicut Point will be submitted and a continuing contract, as authorized in the original act, entered into, after due advertisement according to law, for completing the channel. It is proposed to apply the $200,000 estimated for fiscal year ending June 30, 1900, together

with such balances as may be available, to continuing this work below Conimicut Point.

Providence River is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence in the last calendar year was $198,734.22. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are fort on Dutch Island and Fort Adams, R. I.

Money statement.

July 1, 1897, balance unexpended		$143,152.79
June 30, 1898, amount expended during fiscal year		73,128.78
July 1, 1898, balance unexpended		70,024.01
July 1, 1898, outstanding liabilities	$17,050.70	
July 1, 1898, amount covered by uncompleted contracts	20,498.87	
		37,549.57
July 1, 1898, balance available		32,474.44

Amount (estimated) required for completion of existing project	582,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	200,000.00
Submitted in compliance with requirements of sections 2 of river and habor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

AMOUNTS APPROPRIATED.

August 30, 1852	$5,000.00	August 5, 1886	$30,000.00
August 30, 1852 (survey)	1,500.00	August 11, 1888	40,000.00
May 2, 1867	25,000.00	September 19, 1890	50,000.00
July 11, 1870	5,000.00	July 13, 1892	50,000.00
July 15, 1870	2,500.00	August 18, 1894	17,500.00
June 10, 1872	10,000.00	June 3, 1896	25,000.00
March 3, 1873	10,000.00	June 4, 1897	125,000.00
June 18, 1878	5,000.00	July 1, 1898	125,000.00
June 18, 1878	50,000.00		
March 3, 1879	60,000.00	Total	966,500.00
July 14, 1880	60,000.00	Received from sale of material	143.39
March 3, 1881	60,000.00		
August 2, 1882	125,000.00	Total	966,643.39
July 5, 1884	85,000.00		

Contract in force.

Contractor.	Date of approval.	To commence.	To complete.
P. Sanford Ross	Mar. 10, 1897	Apr. 1, 1897	July 1, 1899

COMMERCIAL STATISTICS.

The commerce arriving and leaving Providence River, Rhode Island, by water during the calendar years ending December 31, 1894–1897, is estimated as follows (based mainly upon reports received from Mr. George H. Webb, secretary of the Board of Trade, Providence, R. I., and Mr. Henry E. Tiepke, commissioner of industrial statistics for the State of Rhode Island):

Class of goods.	1894.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*	*Tons.*
Grains and forage	.....	20,079	19,509	20,600
Lumber and products	60,000	47,503	46,500	64,989
Coal, minerals, etc	1,051,000	1,288,301	1,108,975	1,407,536
Oil, naphtha, etc	.....	.....	.....	41,110
Fertilizers	2,000	366	375	583
General merchandise	521,700	373,094	375,600	559,000
Sundries	9,000	23,063	50,000	59,757
Total	1,643,700	1,753,006	1,600,950	2,152,975

New transportation companies established during the year, none reported.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight and passenger	706	12	600
Freight mainly	261	18	1,433
Passenger mainly	3,201	7	518
Fishing	1,248	3	39
Tugs	1,026	13	100
Pleasure boats	1,300	5	30
Sail:			
Freight	772	18	1,500
Pleasure boats, large	303	7	40
Pleasure boats, small	1,000	3	7
Barges	1,439	16	1,200

C 11.

IMPROVEMENT OF GREEN JACKET SHOAL, PROVIDENCE RIVER, RHODE ISLAND.

Green Jacket Shoal is that part of Providence River which lies off the wharves on the south front of the city of Providence, being an important part of the harbor for anchorage purposes.

Original condition.—That part of the harbor in which the shoal is located is about 2,000 feet long by from 600 to 1,200 feet wide; and of this area, the shoal occupied about 30 acres, that part of it which was included between the 15-foot curves measuring about 18 acres. There were channels on either side of the shoal, between it and the harbor lines, having at mean low water a width of 300 feet and a depth of 20 feet on the north side, and a width varying from 50 to 100 feet and a depth of about 15 feet on the south side. The water on the summit of the shoal was only 1 foot deep.

Plan of improvement.—The present approved project, that of 1885, provides for the removal to 25 feet depth at low water of a middle-ground shoal of about 30 acres area in Providence River opposite the city, no portion of the shoal within 200 feet of the harbor lines of the city to be removed by the General Government; all at a total cost estimated in 1885 at $112,346.

A plan of the works may be found at page 598, Annual Report of the Chief of Engineers for 1885, and pages 830 and 832 of 1893.

Amount expended and results to June 30, 1897.—The total amount expended on the present project up to June 30, 1897, was $103,896.99, by which 23.8 acres (out of the original 30) had been dredged to 25 feet depth, and a 16-foot depth had been secured over the remaining central and largest portion of the shoal, making an important addition to the anchorage facilities of the harbor.

Operations during the past fiscal year.—The amount expended during the past fiscal year was $20.75. No operations were in progress during the year, owing to the practical exhaustion of funds. Further work awaits further appropriations.

Work required to complete the existing project.—The work required to complete the existing project is the further deepening of the entire area to its full depth of 25 feet.

Operations contemplated for the fiscal year ending June 30, 1899.—Nothing contemplated, there being no funds available.

Green Jacket Shoal is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence during the last calendar

year was $198,734.22. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are Fort Adams, R. I., and the fort on Dutch Island.

Money statement.

July 1, 1897, balance unexpended	$353.01
June 30, 1898, amount expended during fiscal year	20.75
July 1, 1898, balance unexpended	332.26
Amount (estimated) required for completion of existing project	8,096.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	8,096.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

AMOUNTS APPROPRIATED.

Present project.

August 5, 1886	$26,250	August 18, 1894	$7,500
August 11, 1888	28,000	June 3, 1896	7,500
September 19, 1890	25,000		
July 13, 1892	10,000	Total	104,250

For the commercial statistics, see report of improvement of Providence River and Narragansett Bay, Rhode Island.

C 12.

IMPROVEMENT OF WICKFORD HARBOR, RHODE ISLAND.

Wickford Harbor is an arm of Narragansett Bay lying west of the north end of Conanicut Island, about 18 miles south of Providence and about 12 miles northwest of Newport, R. I. The entrance is obstructed by a number of bowlders and the harbor itself is shoal.

The harbor owes its importance to the fact that it is the water terminus of the Wickford Railroad, which connects with the New York, New Haven and Hartford Railroad at Wickford Junction, and, in connection with a ferryboat making six round trips daily between Wickford and Newport, forms the shortest line of communication between the latter point and New York and other points west.

The mean rise and fall of the tide is 4.2 feet.

Original condition.—Before improvement the channel had a ruling depth of about 6 feet at mean low water.

At the adoption of the present project the channel, extending from the steamboat wharf near the entrance to the harbor up to the wharves of the town of Wickford, was winding and about 6 feet deep, and the entrance to the harbor and the channel were obstructed by bowlders.

Plan of improvement.—The project of 1896 provides for removing certain of the worst bowlders and dredging a channel 60 feet wide and 9 feet deep at mean low water, with enlargements at the bends, up to the wharves in Wickford.

Amount expended and results to June 30, 1897.—The amount expended up to June 30, 1897, was $15,563.89, which removed some of the bowlders from the entrance to the harbor and completed the channel to the depth

and width projected, i. e., of 60 feet width and 9 feet depth at mean low water up to the steamboat wharf.

Operations during the past fiscal year.—No work has been done and no funds expended during the past fiscal year.

Operations contemplated for the fiscal year ending June 30, 1899.—It is proposed to apply the funds available to removing a few additional bowlders.

Wickford is in the collection district of Newport. The amount of revenue collected at Newport in the last calendar year was $2,015. The nearest light-house is Wickford Harbor Light. The nearest fortification is fort on Dutch Island, Rhode Island.

Money statement.

July 1, 1897, balance unexpended	$736.11
July 1, 1898, balance unexpended	736.11

AMOUNTS APPROPRIATED.

March 3, 1873	$5,000
June 23, 1874	5,000
June 3, 1896	6,300
Total	16,300

COMMERCIAL STATISTICS.

The commerce arriving and leaving Wickford Harbor, Rhode Island, by water, during the calendar years ending December 31, 1896–97, is estimated as follows (based mainly upon reports received from Mr. Thomas J. Pierce, town clerk, Wickford, R. I.):

Class of goods.	1896.	1897.
	Tons.	*Tons.*
Cotton and products	100	150
Tobacco	10	10
Rice	4	4
Grains and forage	750	950
Vegetables and truck	25	25
Live stock and products	125	200
Fish, oysters, etc	475	850
Naval stores	6	6
Lumber and products	2,014	2,200
Coal, minerals, etc	11,100	12,000
Fertilizers	50	50
General merchandise	200	350
Sundries	50	50
Total	14,909	16,845

New transportation companies established during the year, none.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
Steam:		*Feet.*	*Tons.*
Freight and passenger	1,200	7	332
Fishing	50	6	50
Tugs	150	7	80
Pleasure boats	250	7	100
Sail:			
Freight	185	8	250
Fishing boats	250	3	5
Pleasure boats, large	75	7	50
Pleasure boats, small	400	3	2
Barges	16	12	600

C 13.

IMPROVEMENT OF NEWPORT HARBOR, RHODE ISLAND.

Newport Harbor is at the main entrance to Narragansett Bay. This bay during the entire year offers an easily accessible harbor of refuge for our European and coastwise commerce quite equal in almost every respect to any harbor on this coast. Newport Harbor, lying at the eastern entrance to this bay and forming a part of it, has been used by vessels from very early times on account of its accessibility and well-sheltered location.

The objects of the improvement are to widen and deepen the entrance to the harbor and to enlarge its capacity for vessels seeking refuge in storms by increasing the area and depth of the anchorage within it. The mean rise and fall of the tide is about 3.75 feet.

Original condition.—Before improvement the capacity of the inner harbor was limited by shoals, and it was not sufficient for the vessels seeking it for refuge. The southern (main) entrance was obstructed by a bar which stretched out from Goat Island, and the northern entrance, near Rose Island, by a sharp rocky spit, and the general business wharves of the city could not be reached at low tide by vessels drawing more than 8 feet.

At the adoption of the present project this harbor was limited to 12 feet depth at low water, and its anchorage area too small for the craft seek harborage at this place during the summer and all the year during storms.

Plan of improvement.—The present approved project, that of 1880, as modified in 1882, 1883, 1884, 1890, and 1895, provides for the widening and deepening of the channel, from Narragansett Bay into Newport, so as to secure 15 feet depth at low water, with at least 750 feet width; for the extension of the 13-foot depth and 10-foot depth anchorage basins, and for dredging a channel 10 feet deep along the harbor line south from Commercial Wharf to a point opposite the gas company's wharf; for the partial cutting off of the shoal spit at the southern end of Goat Island, and for the construction of jetties on the western shore of Goat Island so as to protect the end of this island from erosion, and to prevent the drift of sand, etc., around the island into the adjacent parts of the channel and harbor, and for the removal of "Spindle Rock," a sharp rocky spit near Rose Island; all at a total cost estimated in 1895 at $206,200.

A plan of the works may be found at page 604, Annual Report of the Chief of Engineers for 1885, and page 838 of 1893; and further details at page 562 of 1881, page 561 of 1882, page 494 of 1883, page 624 of 1884, page 736 of 1891, and page 627 of 1892.

Amount expended and results to June 30, 1897.—The amount expended to June 30, 1897, was $180,423.80. The $28,500 appropriated between 1873 and 1875 had been expended in dredging a 12-foot channel up to the city wharves and in building a small jetty to arrest the flow of sand into the main channel and harbor, and to protect the western side of Goat Island. This work was completed in 1876. Of the work under the present project the 15-foot depth channel at the southern entrance to the harbor had been completed; the 10-foot depth channel along the harbor line south from Commercial Wharf to a point opposite the gas company's wharf, the cutting off of the spit at the southern end of Goat Island, and a jetty on the western side of the island had been nearly completed. The 13-foot depth anchorage area had been completed, a

small part of the 10-foot anchorage area had been dredged, and 409.14 cubic yards of rock had been removed from "Spindle Rock," near Rose Island, securing a depth of 8.5 feet at low water over the remaining portion of the rock.

Operations during the past fiscal year.—The amount expended during the past fiscal year was $76.70.

No dredging or stonework was in progress during the fiscal year for want of funds. At the date of this report the improvement is in good condition.

In July, 1897, a recommendation was submitted for a change in the harbor lines as established by the State in the harbor of Newport, R. I. The papers were returned to this office the same month with directions to arrange for a public hearing at Newport in regard to this matter, and said hearing was held on August 18, 1897, and report submitted thereon on September 11, 1897. Under date of September 24 instructions were received to make a resurvey of the water front of Newport Harbor, and said survey has been made and map platted. By Department instructions of December 10, 1897, the subject of establishment of harbor lines at Newport Harbor was referred to the Board of Engineers constituted by Special Orders No. 44, Headquarters, Corps of Engineers, December 1, 1897, and directed that a public hearing be granted to all interested parties, and said hearing was held before said Board on the 11th of January, 1898. Preliminary report was submitted on January 27, 1898.

The survey was under charge of Mr. C. M. Winchell, assistant engineer.

Work required to complete the existing project.—The work required to complete the existing project is the excavation of the remainder of the 10-foot anchorage area within the harbor and the building of additional jetties outside of Goat Island, whenever they may be required to arrest the drift of littoral sand and gravel into the harbor entrance.

Operations contemplated for the fiscal year ending June 30, 1899.—Nothing contemplated excepting establishment of harbor lines, there being no funds available.

Newport is in the collection district of Newport, and is a port of entry. The amount of revenue collected at Newport in the last calendar year was $2,015. The nearest light-houses are Lime Rock and Newport (Goat Island) lights. The nearest fortification is Fort Adams, R. I.

Money statement.

July 1, 1897, balance unexpended	$85.72
June 30, 1898, amount expended during fiscal year	76.70
July 1, 1898, balance unexpended	9.02
Amount (estimated) required for completion of existing project	54,200.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	54,200.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

AMOUNTS APPROPRIATED.

March 3, 1873	$8,500.00	September 19, 1890	$12,500.00
June 23, 1874	10,000.00	July 13, 1892	25,000.00
March 3, 1875	10,000.00	August 18, 1894	7,500.00
March 3, 1881	25,000.00	June 3, 1896	15,000.00
August 2, 1882	20,000.00	Received from sale of material	8.52
July 5, 1884	20,000.00		
August 5, 1886	15,000.00	Total	180,508.52
August 11, 1888	12,000.00		

COMMERCIAL STATISTICS.

The commerce arriving and leaving Newport Harbor, Rhode Island, by water during the calendar years ending December 31, 1893–1897, is estimated as follows (based mainly upon reports received from Mr. Martin H. Ball, deputy collector of customs, and other citizens of Newport, R. I.):

Class of goods.	1893.	1894.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Cotton and products	150	150	175	150	160
Tobacco	25	50	25	30	40
Grains and forage	2,000	1,000	850	1,500	2,000
Vegetables and truck	400	600	10,535	12,000	13,000
Live stock and products	70	2,400	40,281	45,000	45,000
Fish, oysters, etc	500	8,000	136,644	138,000	150,000
Naval stores	.....	80	1,239	1,200	1,300
Lumber and products	10,500	13,260	13,000	15,000	21,000
Coal, minerals, etc	95,500	75,000	50,000	75,000	73,000
Fertilizers	1,400	125	250	300	400
Machinery	425	.....	.....	200	1,000
General merchandise	15,000	15,000	121,152	125,000	127,500
Sundries	3,000	3,000	.....	500	500
Total	128,970	118,665	374,151	413,880	434,900

New transportation companies established during the year, none reported.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
Steam:		*Feet.*	*Tons.*
Freight and passenger	1,350	12	1,500
Freight, mainly	375	10	1,000
Passenger, mainly	3,600	8	500
Fishing	400	7	160
Tugs	700	7	80
Pleasure boats	1,200	7	100
Sail:			
Freight	840	10	150
Fishing boats	650	6	20
Pleasure boats, large	1,600	6	10
Pleasure boats, small	2,500	3	3
Barges, freight	200	12	500

C 14.

HARBOR OF REFUGE AT POINT JUDITH, RHODE ISLAND.

Point Judith is the southeastern extremity of South Kingston, R. I., and marks the southwestern entrance to Narragansett Bay.

At the adoption of the present project this point was a specially dangerous place for boats and tows to pass during storms and even ordinarily bad weather.

Plan of improvement.—The present approved project, that of 1889, provides for the construction of a national harbor of refuge nearly a mile square at this point by means of stone breakwaters built partly on Squid Ledge and planned so as to give protection against easterly, southerly, and westerly storms, the mainland itself forming a protection on the north; all at a total cost estimated in 1889 at $1,250,000.

By the act of July 13, 1892, authority was given to the Secretary of War to make contracts for the completion of the project on the basis of the above estimated total cost, the work to be paid for as appropriations may from time to time be made by law.

A description of the works may be found at page 595, Annual Report of the Chief of Engineers for 1890, and a general plan of the same in

House Ex. Doc. No. 66, Fifty-first Congress, first session, and page 840 of 1893.

Amount expended and results to June 30, 1897.—The total amount expended on the present project up to June 30, 1897, was $900,093.82, by which the breakwater had been commenced at its center, extended to a total length of about 5,760 feet on the bottom, of which 3,860 feet of the eastern arm had been built up to its full height and width on top and an additional length of 200 feet sloping off from the eastern end had been built, making the entire length of the eastern arm 4,060 feet on the bottom. The remaining 1,700 feet in the western arm was built well above the level of high water and the greater part of this up to the full height of 10 feet above mean low water, but it all needed widening out and the building up of the outer slopes. Three beacon lights had been established and maintained thereon.

The storms during the winter of 1896–97 carried off some of the top stones, but no serious damage had been done. On September 9, 1896, a severe gale, accompanied by an unusually high tide, visited this locality and caused considerable damage to the top of the breakwater. In consequence of the damage thus sustained a Board of Engineers was convened to consider and report upon the subject of the construction of the harbor of refuge at Point Judith, Rhode Island. The report of this Board (see page 920, Annual Report of Chief of Engineers for 1897) recommends the raising of the crest of the eastern arm of the breakwater to 9 feet above high water, the present height being 6 feet, and the postponement of the construction of the detached eastern breakwater until after the completion of the main work may demonstrate the necessity or otherwise of such a structure for additional shelter.

Operations during the past fiscal year.—The amount expended during the past fiscal year was $151,173.21.

The work of constructing the breakwater under the continuous contract with Messrs. Hughes Bros. & Bangs, of Syracuse, N. Y., in progress at the beginning of the fiscal year, was continued throughout the year, with the exception of about one month during December and January. During the year 130,791.76 tons of stone were placed in the breakwater (making a total under the contract of 765,813.76), the greater portion of which was used to complete the 200 feet at the eastern end to full dimensions and to build up the sea slope of 1 on 2 of the east wing, and the remainder used to build up and extend the western arm, which now has a length on the bottom of 2,100 feet from the central beacon.

The breakwater has now a total length on the bottom of about 6,160 feet.

During October and December it was unusually stormy, and very high seas broke over the breakwater, but so far as can be seen no damage was done.

From the fact that 84 steamers, 279 schooners, 73 sloops, and 49 barges took refuge behind the breakwater during eleven months of the past year, the evidence is conclusive that the structure is commencing to be of some service to the maritime world.

This work was under the local charge of Mr. Edward Parrish as assistant engineer, with Mr. John A. Dill as inspector.

Work required to complete the existing project.—The work required to complete the existing project is the building up and extension of the breakwater.

The completion of the project, as recommended by The Board of Engineers, involves the placing of 310,533 tons of stone, in addition to

the amount covered by the existing contract, which it is estimated will cost $444,311.

Operations contemplated for the fiscal year ending June 30, 1899.—It is proposed to apply the available funds to continuing the construction of the breakwater.

Point Judith is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last calendar year was $2,015. The nearest light-house is Point Judith Light. The nearest fortification is the fort on Dutch Island, Rhode Island.

Money statement.

July 1, 1897, balance unexpended		$349,944.79
June 30, 1898, amount expended during fiscal year		151,173.21
July 1, 1898, balance unexpended		198,771.58
July 1, 1898, outstanding liabilities	$46,243.96	
July 1, 1898, amount covered by uncompleted contracts	135,746.42	
		181,990.38
July 1, 1898, balance available		16,781.20
Amount (estimated) required for completion of existing project		444,310.98
Amount that can be profitably expended in fiscal year ending June 30, 1900		444,310.98
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

AMOUNTS APPROPRIATED.

September 19, 1890	$75,000.00
July 13, 1892	75,000.00
March 3, 1893	100,000.00
August 18, 1894	100,000.00
March 2, 1895	300,000.00
June 11, 1896	300,000.00
June 4, 1897	300,000.00
	1,250,000.00
Received from sale of material	38.61
Total	1,250,038.61

Contract in force.

Contractor.	Date of approval.	To commence.	To complete.
Hughes Bros. & Bangs	Apr. 3, 1893	May 1, 1893	Indeterminate.

COMMERCIAL STATISTICS.

The tonnage of vessels passing Point Judith, Rhode Island, during the calendar years ending December 31, 1895–1897, is estimated as follows (based mainly upon reports received from Mr. Asa Church, keeper Point Judith Life-Saving Station, Rhode Island):

Class of vessels.	1895.	1896.	1897.
	Gross tons.	*Gross tons.*	*Gross tons.*
Steamers (freight and fish)	6,000,000	6,000,000	6,400,000
Yachts (steam and sail)	700,000	700,000	700,000
Schooners (2, 3, and 4 masts)	20,400,000	21,400,000	21,500,000
Ships, barks, and barkentines	180,000	180,000	180,000
Brigs and brigantines	60,000	60,000	60,000
Sloops	40,000	40,000	40,000
Barges	4,840,000	5,000,000	5,100,000
Total	32,220,000	33,380,000	33,980,000

C 15.

IMPROVEMENT OF ENTRANCE TO POINT JUDITH POND, RHODE ISLAND.

Point Judith Pond is a shallow salt pond, lying in rear of the sandy beach of the Rhode Island shore, just west of Point Judith.

The improvement desired at this place by the people of the neighborhood is the reopening of an old entrance long ago closed by the ocean storms.

The present entrance to this pond is very shallow (less than 3 feet), crooked, and variable in location, and lies about a mile to the westward of the former entrance (now closed), where the improvement is desired.

Plan of improvement.—There is at present no approved project for this work, it having been reported as not worthy of improvement in 1873 by General Warren (pp. 286–289, part 2, Annual Report of the Chief of Engineers for 1874, and House Ex. Doc. No. 84, Forth-third Congress, first session) and also in 1888 by Major Livermore (pp. 642–643, Annual Report for 1889), and also in 1893 by Captain Bixby (see pp. 841 and 879, Annual Report for 1893). The appropriation for 1894 orders that all money so far appropriated shall be used in improving the former entrance to said pond.

Amount expended and results to June 30, 1897.—The total amount expended on this work up to June 30, 1897, was $518.38, by which a survey of the locality had been made. A report of this survey, with estimate and project, was submitted July 2, 1895, and printed at page 689, Annual Report of the Chief of Engineers for 1895, and by direction of the Secretary of War further action was delayed until the subject can again be considered by Congress. No field work has yet been done except in the way of examination and survey.

Operations during the past fiscal year.—No work done and no funds expended during the past fiscal year.

Point Judith Pond is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last calendar year was $2,015. The nearest light-house is Point Judith Light. The nearest fortification is the fort on Dutch Island, Rhode Island.

Money statement.

July 1, 1897, balance unexpended	$9,481.62
July 1, 1898, balance unexpended	9,481.62

AMOUNTS APPROPRIATED.

July 13, 1892	$7,500
August 18, 1894	2,500
Total	10,000

For the commercial statistics, see harbor of refuge at Point Judith, Rhode Island.

C 16.

HARBOR OF REFUGE AT BLOCK ISLAND, RHODE ISLAND.

This island is part of the State of Rhode Island; is 14 miles east of Montauk Point, the eastern end of Long Island, and is about 10 miles from the nearest point of the mainland. Besides supplying the wants of the mackerel-fishing fleet and the general coast navigation, the island is an important point on our shores for ocean navigation. It has

a signal station connected by submarine telegraph with the mainland. Vessels are passing the island at all times and on all sides of it, and its position renders it of national importance. The object of the improvement is to furnish a harbor of refuge for medium-draft vessels engaged in foreign and coastwise commerce. The mean rise and fall of the tide is about 3 feet.

Original condition.—Before the construction of the present harbor of refuge Block Island had no harbor which afforded protection for decked vessels. The only ones used were open boats, which on the approach of storms were hauled up on the beach by oxen. The largest of these boats were of about 10 tons burden.

Plans of improvement.—Between 1870 and 1876, $285,000 was appropriated to build a breakwater for a harbor for medium-draft vessels. This work, including an inner harbor of 7 feet depth for temporary use of the Government plant, was completed in 1878. (See p. 202 of Annual Report for 1877 and p. 313 of 1879.)

In 1880, $6,000 was appropriated for dredging the inner basin to 9 feet depth. This work was completed in 1881. (See p. 390 of Annual Report for 1880 and p. 563 of 1881.)

In 1882, $19,000 was appropriated for building a sea wall on the east side of the inner basin and protecting the cliffs on east side of breakwater. (See p. 563 of Annual Report for 1882.) This work was completed in 1884.

In 1884, $15,000 was appropriated for additions to the old breakwater. (See p. 628 of Annual Report of 1884.) These additions were made in 1884–85, partially closing a gap in this old breakwater.

The project of 1884, as modified in 1888, provided for the construction of a harbor of refuge on the eastern side of the island, consisting of an enlarged inner harbor (or basin) for small vessels and an exterior harbor for large ones. The basin was to be about 800 feet square and completely inclosed except at its 100-foot-wide entrance. The exterior harbor was already formed by an old breakwater on the east and the adjacent shore on the south and west, but an old gap near the end of this breakwater was to be filled up. The project covered the construction of the stone sea walls of the enlarged inner harbor ($46,000), the repair of the old breakwater ($24,000), and a little dredging ($5,000) along the western side of the old breakwater and also inside the harbor; all at a total cost estimated in 1888 at $75,000. This project was practically completed in 1893.

The present approved project, that of 1895, based on the report of the survey ordered in the river and harbor act of August 17, 1894, provides for raising the entire breakwater to proper height, and stopping sand leaks between certain points, and dredging the main inner harbor to a depth of 10 feet, at an estimated cost of $83,985.

A plan of the works may be found at page 612, Annual Report of the Chief of Engineers for 1885, page 844 of 1893, and in House Doc. No. 83, Fifty-fourth Congress, first session; and further details at pages 609 and 613 of 1885 and page 506 of 1888.

Amount expended and results up to June 30, 1897.—The total amount expended up to June 30, 1897, was $401,824.36, by which the gap in the old breakwater had been filled up so as to make the breakwater of 1,900 feet total length; the sea walls of the inner harbor had been completed (except as to stone fender piers at the entrance); wooden fender piers had been built for present uses, the worst rocks and bowlders had been removed from the new inner harbor, and a small amount of dredging had been done from time to time, at the entrance to the inner harbor, where a shoal was constantly forming. An agreement had been made in June, 1897, with Capt. T. A. Scott to remove about

5,000 cubic yards of sand from this troublesome shoal, at 35 cents per cubic yard, and 2,258 cubic yards had already been removed.

Operations during the past fiscal year.—The amount expended during the past fiscal year was $2,268.77.

Work of dredging in operation at the close of the past fiscal year, under the above-mentioned agreement, was completed on the 20th of July, 1897, by the removal of 2,742 cubic yards of sand from the shoal, to a depth of 10 feet at low tide.

Under present conditions the entrance to the harbor is liable to shoal up each year, by reason of sand carried through the main breakwater during easterly storms. This will continue until the breakwater is made sand tight, as provided for in project of 1895; but in order to carry this work on properly and economically, sufficient money should be appropriated to complete this part of the project in one season; otherwise, unless the necessary funds are provided for maintaining the channel at the entrance by dredging it out each year at a cost of about $2,500, it will close up and the inner harbor become practically useless except for boats of a very light draft.

Lights have been maintained on the north sea wall during the year.

This work was in the local charge of Mr. Edward Parrish as assistant engineer, with Mr. Lester E. Dodge as inspector.

Work required to complete the existing project.—The work required to complete the existing project is to repair the main breakwater and stop sand leaks through certain portions of it, and to dredge the enlarged inner harbor to a depth of 10 feet.

Operations contemplated for the fiscal year ending June 30, 1899.—It is proposed to retain a small amount of available funds to keep the entrance to the inner harbor open until sufficient funds are available to provide for effective work in repairing the main breakwater.

Block Island is in the Newport collection district, and Newport is the nearest port of entry. The revenue collected at Newport during the last calendar year was $2,015. There is no duty collected at Block Island. The value of the harbor is mainly as a harbor of refuge. There are several lights on the island. The nearest fortification is Fort Adams, R. I.

Money statement.

July 1, 1897, balance unexpended	$4,675.64
June 30, 1898, amount expended during fiscal year	2,268.77
July 1, 1898, balance unexpended	2,406.87
July 1, 1898, outstanding liabilities	30.00
July 1, 1898, balance available	2,376.87
Amount (estimated) required for completion of existing project	78,985.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	78,985.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

AMOUNTS APPROPRIATED.

July 11, 1870	$30,000	July 5, 1884	$15,000
March 3, 1871	75,000	August 5, 1886	20,000
June 10, 1872	50,000	August 11, 1888	15,000
March 3, 1873	50,000	September 19, 1890	15,000
June 23, 1874	20,000	July 13, 1892	24,000
March 3, 1875	20,000	August 18, 1894	2,500
August 14, 1876	40,000	June 3, 1896	5,000
June 14, 1880	6,000		
August 2, 1882	19,000	Total	406,500

COMMERCIAL STATISTICS.

The commerce arriving and leaving Block Island, Rhode Island, by water during the calendar years ending December 31, 1892–1897, is estimated as follows (based mainly upon reports received from Mr. C. C. Ball, Block Island, Rhode Island):

Class of goods.	1892.	1893.	1894.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Cotton and products	.....	5	5	.....	10	10
Tobacco	30	30	30	30	30	32
Rice	10	20	10	10	12	12
Grains and forage	560	800	1,050	1,130	1,250	1,300
Vegetables and truck	270	350	480	515	650	650
Live stock and products	740	2,000	1,100	2,100	2,500	2,600
Fish, oysters, etc	8,280	2,500	10,250	10,050	15,000	15,000
Naval stores	.....	.....	10	5	10	10
Lumber and products	5,170	5,000	4,100	7,000	6,500	6,500
Coal, minerals, etc	6,660	7,401	10,000	8,650	15,000	15,000
Fertilizers	90	120	130	150	200	300
Machinery	10	10	.....	.....	100	100
General merchandise	4,500	6,000	7,000	6,625	6,600	6,700
Sundries	6,300	13,000	9,000	8,870	2,500	3,500
Total	32,600	37,235	43,165	45,135	50,302	51,714

New transportation companies established during the year, none reported.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight and passenger	750	7	500
Fishing	600	7.5	130
Tugs	400	7.5	135
Pleasure boats	1,300	7	125
Sail:			
Freight	300	9	150
Fishing boats	6,000	7	30
Oyster boats	200	6	30
Pleasure boats, large	1,200	8	15
Pleasure boats, small	6,500	5.5	7
Barges	30	10	350

C 17.

IMPROVEMENT OF GREAT SALT POND, BLOCK ISLAND, RHODE ISLAND.

The Great Salt Pond is a large pond of salt water, lying about the center of Block Island. Before the commencement of the present improvement it was separated from the ocean on the west by a comparatively narrow strip of sandy shore. The State of Rhode Island and the town of New Shoreham have appropriated altogether $115,000 toward establishing a channel from deep water in the ocean to deep water in the pond and protecting same by stone jetties.

With the funds thus appropriated the local authorities have built 837 feet of the southern jetty and carried the northern jetty out for a short distance, besides dredging a channel about 450 feet wide, with a minimum width of 150 feet, carrying at least 12 feet of water at low tide.

Plans of improvement.—The present approved project, that of 1895, provides for extending the south jetty out to the 18-foot contour and the north jetty to the 12-foot contour, also for dredging a channel having a central depth of 25 feet with a width of 150 feet, gradually shoal-

ing to a depth of 12 feet with a width of 504 feet, thence to high water line with a slope of 1 on 4, the total width at low water to be 600 feet. All at a total estimated cost, exclusive of the expenditures of the State and town, of $97,567.94.

At the time Lieut. Col. S. M. Mansfield, Corps of Engineers, made his report on this improvement the price per cubic yard for dredging was 10.7 cents, and his estimate for completing the work was based on these figures. Since then considerable hard clay and bowlders have been found in the dredging and the price paid per cubic yard has been 14⅞ cents, which would change the estimate for completion considerably.

The report of survey with map was published as House Doc. No. 57, Fifty-fourth Congress, first session, and the report, with map omitted, at page 620, Annual Report of the Chief of Engineers for 1896.

Amount expended and results up to June 30, 1897.—The total amount expended on this project by the Government up to June 30, 1897, was $26,890.24, by which 25,701 tons of stone had been placed in the south jetty, extending the same to the 18-foot contour, 1,262 feet from shore, and nearly completing work under the contract with Messrs. S. & E. S. Belden, of Hartford, Conn., at $1.33 per ton for stone in place in the jetty.

Operations during the past fiscal year.—The work of jetty construction in progress at the commencement of the fiscal year under the above-mentioned contract was completed on the 9th of July, 1897, by placing 1,200 tons of stone in the south jetty, building up all low portions of the jetty to full width and height.

A minor survey was made in August to determine the condition of the channel entrance with a view to preparation for future work. During June, 1898, a diving crew in a small sailboat sought for an obstruction in the channel entrance complained of from time to time, and removed a long bent piece of 1¼-inch iron pipe.

This work was in the local charge of Mr. Edward Parrish, assistant engineer, with Mr. Kneeland P. Partelow as inspector, and the survey was in charge of Assistant Engineer C. M. Winchell.

Work required to complete the existing project.—The deepening and widening of the channel and the extension of the north jetty.

Operations contemplated for the fiscal year ending June 30, 1899.—It is proposed to apply the available funds to dredging.

Great Salt Pond is in the Newport collection district, and Newport is the nearest port of entry. The revenue collected at Newport during the last calendar year was $2,015. There is no duty collected at this place. The value of the harbor is mainly as a harbor of refuge. There are several light-houses at the island. The nearest fortification is Fort Adams, R. I.

Money statement.

July 1, 1897, balance unexpended	$13,109.76
June 30, 1898, amount expended during fiscal year	10,978.59
July 1, 1898, balance unexpended	2,131.17
July 1, 1898, outstanding liabilities	50.00
July 1, 1898, balance available	2,081.17
Amount (estimated) required for completion of existing project	57,567.94
Amount that can be profitably expended in fiscal year ending June 30, 1900	57,567.94

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

AMOUNT APPROPRIATED.

June 3, 1896	$40,000

Contract in force.

Contractor.	Date of approval.	To commence.	To complete.
S. & E. S. Belden	Oct. 12, 1896	Oct. 15, 1896	July 1, 1897

COMMERCIAL STATISTICS.

The commerce arriving at and leaving the Great Salt Pond, Block Island, Rhode Island, by water during the calendar years ending December 31, 1896-1897, is estimated as follows (based mainly upon reports received from Mr. C. E. Champlin, of Block Island, Rhode Island):

Class of goods.	1896.	1897.
	Tons.	*Tons.*
Grain and forage	1,600	2,000
Vegetables and truck	100	200
Fish, oysters, etc	2,000	5,000
Lumber and products	900	1,000
Coal, minerals, etc	250	500
General merchandise	250	500
Sundries	100	500
Total	5,200	9,700

New transportation companies established during the year, none.

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
Steam:		*Feet.*	*Tons.*
Freight and passenger	700	10	500
Fishing	100	10	100
Sail:			
Fishing vessels (schooners)	4,000	11	100
Fishing boats	4,500	5	10
Pleasure boats, large	100	3	5
Barges	500	9	300

C 18.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

1. Schooner R. L. Dewis.—This schooner was wrecked by collision on July 21, 1897, and sank in Vineyard Sound, about midway between Hedge Fence and Squash Meadow Shoals, in about 54 feet of water. By Department indorsement of September 13, 1897, her removal was authorized and $500 allotted therefor.

The work of her removal by hired labor was completed on September 25, 1897, and a final inspection made on that date showed a least depth of 35 feet at low water over the remaining portions of the wreck.

The total cost of the work was $459.87.

2. Schooner Mary B. Smith.—The wreck of this schooner was found in about 10 feet of water at a point about 100 yards from the southeast shore of Vineyard Haven, and about halfway between the black and red buoys in Vineyard Haven Harbor, Massachusetts, was reported October 2, 1897, and by Department letter of October 5, 1897, her removal was authorized and $500 allotted therefor.

This wreck was completely broken up and removed during the month of November, 1897, by hired labor, at a total cost of $353.99.

3. Wreck off Quonocontaug, R. I.—The spars of an unknown wreck in Block Island Sound were reported March 11, 1898, and by Depart-

ment letter of March 16, 1898, an allotment of $250 made for their removal. These spars are reported to show above the water from 4 to 8 feet, at a point about 4 miles south of the Quonocontaug Life-Saving Station, R. I. These spars will be removed during the early part of the next fiscal year.

4. Schooner Asia.—The wreck of the schooner *Asia* was reported March 11, 1898, and by Department indorsement of March 22, 1898, an allotment of $800 made for her removal. This wreck is reported sunk in about 8 feet of water on Killpond Bar, about 1 mile E. SE. of the Bass River (Massachusetts) Light Station. The removal of this wreck will be undertaken at an early date.

5. Barge Excelsior.—The wreck of the barge *Excelsior* was reported March 22, 1898, and by Department letter of March 26, 1898, an allotment of $500 made for her removal. This wreck is reported sunk in about 12 feet of water on Killpond Bar, at a point about 2 miles southeast of the Bass River (Massachusetts) Light Station. Removal of this wreck is yet to be made.

6. Schooner Angola.—The wreck of the schooner *Angola* was reported May 20, 1898, and by Department letter of May 24, 1898, her removal was authorized and $500 allotted therefor. This wreck is reported as sunk in about 50 feet of water at a point about 1¼ miles W. NW. of Cross Rip Light Ship in Vineyard Sound. This wreck has been marked by a lighted gas buoy by the Light House Department. Work of removal not yet commenced.

C 19.

PRELIMINARY EXAMINATION OF HERRING RIVER, HARWICH, MASSACHUSETTS.

[Printed in House Doc. No. 108, Fifty-fifth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 1, 1897.

SIR: I have the honor to submit the accompanying copy of report, dated September 13, 1897, by Maj. D. W. Lockwood, Corps of Engineers, upon a preliminary examination of Herring River, in Harwich, Mass., made to comply with the provisions of the river and harbor act of June 3, 1896.

It appears that the expense for constructing suitable works for obtaining a channel of even moderate depth would be great, while the cost of its maintenance would be an important item, owing to the movement of sand along the shore. A harbor at the locality would be a convenience for pleasure boats during the summer, but, in a general sense, there is no local commerce, and none can be anticipated at all commensurate with the expense that would be incurred in securing a channel of even a very moderate depth.

Major Lockwood states that any improvement at this locality would be purely local in its benefits, and, for this and other reasons given, he does not consider Herring River to be worthy of improvement by the General Government. These views are concurred in by the Division Engineer, Col. G. L. Gillespie, Corps of Engineers, and by me.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers,
U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF MAJ. D. W. LOCKWOOD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Newport, R. I., September 13, 1897.

GENERAL: In compliance with the river and harbor act of June 3, 1896, and orders from your office dated June 16, 1896, I have the honor to submit the following report of a preliminary examination of Herring River, in Harwich, Mass.:

The locality was visited by me August 19, 1897.

The mouth of Herring River is 6¾ miles west of Stage Harbor light, and is 9 miles due east of Hyannis light.

The low-water width of this stream at its mouth is about 60 feet, with but little depth. The stream itself furnishes an outlet into Nantucket Sound for several ponds of considerable area, is of varying width, and is claimed to have a low-water depth of 5 feet from the highway bridge, about one-quarter of a mile from its mouth, down to near the shore line. A bulkhead has been constructed along the west bank from a short distance above the shore out into the sound for several hundred feet, and the shore line has made out just as the bulkhead has been extended; in fact, the movement of sand to the east is such that the shore line would probably follow the bulkhead or pier even if it were carried out to a much greater distance. The distance from the shore out to the 6-foot curve of low water according to the Coast Survey chart is one-quarter of a mile.

The expense of constructing suitable works for obtaining a channel of even moderate depth at this point would be great, and the cost of maintaining the channel would be an important item owing to the movement of sand along the shore. A harbor at this point would be a convenience for pleasure boats during the summer, but, in a general sense, there is no local commerce at present, and none can be anticipated at all commensurate with the expense that would be incurred in securing a channel of even a very moderate depth. Killpond Bar furnishes good protection and an anchorage for vessels of considerable size during heavy weather from the south and southwest, while Monomoy Point breaks southeasterly seas.

Any improvement here would be purely local in its benefits, and for this and other reasons given I do not consider the locality worthy of improvement by the General Government.

Very respectfully, your obedient servant,

D. W. LOCKWOOD,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.
(Through the Division Engineer.)

[First indorsement.]

NORTHEAST DIVISION ENGINEER OFFICE,
New York, September 15, 1897.

Respectfully forwarded to the Chief of Engineers, concurring in the views of the district officer.

G. L. GILLESPIE,
Colonel, Corps of Engineers, Division Engineer.

C 20.

PRELIMINARY EXAMINATION OF SALT POND, HARWICH, MASSACHUSETTS.

[Printed in House Doc. No. 121, Fifty-fifth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 1, 1897.

SIR: I have the honor to submit the accompanying copy of report, dated September 13, 1897, by Maj. D. W. Lockwood, Corps of Engineers, upon a preliminary examination of Salt Pond, in Harwich, Mass., made to comply with the provisions of the river and harbor act of June 3, 1896.

Major Lockwood states that the benefit that would come from having an entrance into the pond would be the affording of a harbor for small pleasure boats of the catboat class, there being no local commerce at present, and no prospective commerce at all commensurate with the cost of securing a depth that would be of any practical use. For the reasons given in the report he does not deem the locality worthy of improvement by the General Government, and his views are concurred in by the Division Engineer, Col. G. L. Gillespie, Corps of Engineers, and by me.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers,
U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF MAJ. D. W. LOCKWOOD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Newport, R. I., September 13, 1897.

GENERAL: In compliance with the river and harbor act of June 3, 1896, and orders from your office dated June 16, 1896, I have the honor to submit the following report of a preliminary examination of Salt Pond, in Harwich, Mass.

The locality was visited by me August 19, 1897.

Salt Pond is 4¼ miles west of Stage Harbor Light and 11½ miles east of Hyannis in a straight line.

The pond itself is oval in shape and about three-quarters of a mile in circumference. The depth is ample for a small harbor.

At present it is connected with Nantucket Sound by a narrow, shallow channel, protected on the west side by a temporary bulkhead of timber, strengthened at its outer end with stone. The effect of this bulkhead has been to advance the shore line on its west side over 200 feet, as is indicated by the original shore line to the east of the entrance, and the indications are that the shore line would advance just in proportion as this bulkhead is extended. Salt Pond has no feeders, that is, no streams empty into it, and the entrance is kept open in the condition it is in at present by the tide.

The flood tide carries into the pond a considerable quantity of sand, and this is deposited over a fan-shaped area where the channel con-

nects with the pond, the result being a broad, flat bar over which there is but little depth at low water. A similar bar also exists in the sound at the mouth of the channel. The distance from the shore out to 6 feet depth in the sound at mean low water, as given on the Coast Survey chart of the locality, is about one-half of a mile.

It is thus apparent that the natural conditions are not favorable for securing a channel of even moderate depth at this point.

The benefit that would come from having an entrance into the pond would be in affording a harbor for small pleasure boats of the catboat class. There is no local commerce at present, and no prospective commerce at all commensurate with the cost of securing a depth that would be of any practical use. For the reasons given, I do not deem the locality worthy of improvement by the General Government.

Very respectfully, your obedient servant,

D. W. LOCKWOOD,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.
(Through the Division Engineer.)

[First indorsement.]

NORTHEAST DIVISION ENGINEER OFFICE,
New York, September 15, 1897.

Respectfully forwarded to the Chief of Engineers, concurring in the views of the district officer.

G. L. GILLESPIE,
Colonel, Corps of Engineers, Division Engineer.

C 21.

SURVEY OF INNER HARBOR AT POINT JUDITH POND, RHODE ISLAND.

[Printed in House Doc. No. 132, Fifty-fifth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 6, 1897.

SIR: I have the honor to submit the accompanying copy of report, dated August 12, 1897, with map,* by Maj. D. W. Lockwood, Corps of Engineers, upon survey of inner harbor at Point Judith Pond, Rhode Island, made to comply with the provisions of the river and harbor act of June 3, 1896.

The plan of improvement presented provides for securing an entrance 300 feet wide, with a central depth of 8 feet, into the pond near the site of the original entrance at its eastern end, and the dredging of a channel of same depth for a distance of 1 mile to reach the 8-foot depth in the pond. The cost, including that of bridging at Great Island, is estimated at $473,490, and the cost of maintaining an entrance into the pond is uncertain.

To reach the towns north of the pond would require the dredging of

* Not reprinted. Printed in House Doc. No. 132, Fifty-fifth Congress, second session.

the small stream on which they are located, and this work, Major Lockwood states, would be very expensive, as the dredged material would in all probability have to be dumped into the ocean or near the south end of the pond. The surveys heretofore made have not been sufficiently in detail to warrant a proper estimate being made for improvement north of the pond, and, in the opinion of the local officer, a survey such as should precede a work of this magnitude would cost $5,000 and should include the whole pond and the stream emptying into it from the north. He also states that the upper part of the pond will freeze over in even ordinarily severe winters, so that continuous navigation, leaving out of consideration the violent storms to which the locality is subject, can not be assured.

Major Lockwood is of the opinion that the locality is not worthy of improvement, as the cost would be entirely out of proportion to the benefits to be conferred, and that the interests are local rather than national.

In forwarding the report to this office the Division Engineer, Col. G. L. Gillespie, Corps of Engineers, concurred in these views.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers,
U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF MAJ. D. W. LOCKWOOD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Newport, R. I., August 12, 1897.

GENERAL: I have the honor to submit herewith a report of a survey of inner harbor at Point Judith Pond, Rhode Island, called for in river and harbor act of June 3, 1896.

Point Judith Pond is about 1 mile west of Point Judith, which is regarded as one of the most dangerous localities on the coast, being exposed to the full sweep from the ocean of southeast storms. Generally speaking the pond is triangular in shape, about 1.25 miles wide at its ocean base, and about 4 miles long from base to apex near Wakefield. The entire area of the pond is about 1,800 acres, of which less than 600 acres has a depth of 6 feet or more, and less than 150 acres a depth of 10 feet or more, these deeper parts being in the shape of long, narrow strips near the middle part of the pond.

The low-water level of the pond is about 2.5 feet above that of the ocean at the present time, although in 1873, when the first survey of this locality was made under the direction of Maj. G. K. Warren, Corps of Engineers, this difference was reported as being even greater.

The pond is separated from the ocean by a sand beach and marsh from 1,000 to 3,000 feet wide at high water, through which, near the west end of the pond, a shallow opening of varying width and depth, but readily fordable by ox teams at all times, extends to the ocean.

It is stated that formerly a waterway, navigable for small schooners, connected the pond with the ocean, and that it was located at its eastern end. The present condition of affairs will hardly warrant this, because openings made since the reported closure of this entrance,

sometime about 1815, have failed to maintain themselves, and the one now existing is cleared out occasionally to prevent the pond becoming stagnant. At the present time an opening into the pond at what is called the site of the old entrance, nearest Point Judith, would find not to exceed 5 feet depth for a distance of over 4,000 feet to the north if the water in the pond remained at its present level; but an entrance of sufficient width and depth for navigable purposes would necessarily lower the pond level so that this distance would be increased to at least 1½ miles.

The present entrance is about 2¼ miles to the west of Point Judith. For about 1 mile west of Point Judith the beach is covered with bowlders and cobblestones from the erosion of the drift deposit forming the point. Beyond this the beach is of sand, with dunes just back of it, built up on a marshy foundation formerly separating the pond from the ocean. The well-defined sand dunes, from 10 to 25 feet above sea level, extend for about 1 mile east of the inlet, leaving about one-quarter of a mile between the drift formation and the dunes covered by a marsh, with small ponds and sandy areas, faced on the ocean side by a revetment of cobblestones thrown up by the sea to an elevation of about 8 feet. This quarter of a mile of intermediate beach is the eastern end of the meeting place of the forces carrying the beach material to the east and west, and should any opening ever be made connecting the pond with the ocean it should, beyond a doubt, be located somewhere in this section. Sometimes in winter, during the continuance of northerly or northwesterly gales, the roll of the sea becomes so far reduced as to permit of the advance of the sand beach to the eastward until it reaches quite to the drift formation, always, however, to be driven back again to the sand dunes during mild weather with southerly winds and a southeasterly sea. As showing the effect of the breakwater in protecting the beach in southerly weather, it was observed that the sand beach remained at its extreme easterly point this season until the 1st of July.

The position of the mouth of the inlet varies. Sometimes it opens toward the westward, with a long point extending from the eastern side, and at others this condition of affairs is reversed. At present the mouth is toward the eastward, with the point on the western side, due to the ebb tide from Block Island and Long Island sounds. The inlet is through soft shifting sand, and at present is limited to a narrow channel of less than 2 feet depth, with probably 6 inches of water rippling over a width of from 100 to 150 feet. Fishermen in the neighborhood state that the inlet closes about every winter, and that when the pond gets too full they get together and dig the opening out.

There is little variation in the level of the pond due to the tide, the mean rise being one-tenth of a foot.

The logical location for any entrance into the pond is near the site of the original entrance at its eastern end, or to the east of Great Island. This island is cultivated, and connected with the mainland by a road and causeway. There will be needed a drawbridge where this road crosses any entrance that might be made.

An entrance, to be of any service to navigation, should have a width of 300 feet, with a central depth of 8 feet. This passageway would require revetting where it crosses the marsh and beach, and the channel into the ocean beyond the shore line would require protection by jetties of riprap stone, the western one being made sand tight. From the marsh north of the beach line a channel would have to be dredged for a distance of a mile to reach 8 feet depth in the pond itself. The

following is an estimate of the cost of what would be required to give 8 feet depth into the pond:

Two jetties at entrance, 800 feet long and 8 feet high above mean low water, 40,000 tons, at $1.50	$60,000
Revetting banks of cut through beach and marsh, 25,000 tons riprap, at $1.50	37,500
Right of way, 34 acres, at $100	3,400
Dredging 1,000,000 cubic yards, at 25 cents	250,000
	350,900
Contingencies, 10 per cent	35,090
Total	385,990

In addition to the above must be added the cost of a bridge where the road to Great Island crosses the cut. This bridge would be 300 feet long, with a swinging drawspan giving 80 feet clear width of opening on each side of the pivot pier. A suitable bridge could probably be built for $25,000, if built of wood, but would require renewal at the end of fifteen years at least. I estimate that the annual cost of repairs to it would be $1,000, and a day and night watchman would require an additional expenditure of $1,500 per annum, or, capitalized at 4 per cent, $2,500 would be $62,500, making the cost of bridging $87,500. This would make the entire cost of the improvement as follows:

Amount brought forward	$385,990
Bridging	87,500
Total	473,490

To reach the towns north of the pond—Wakefield, Peacedale, etc.—would require the dredging out of the small stream on which they are located, and this work would be very expensive, as the dredged material would in all probability have to be dumped in the ocean or near the south end of the pond. The surveys heretofore made have not been sufficiently in detail to warrant a proper estimate being made north of the pond; in fact, a survey such as should precede a work of this magnitude would cost $5,000, and should include the whole pond and the stream emptying into it from the north; and it must be borne in mind that any plan of improvement including a navigable passage to the ocean must be based on a mean low-water level in the pond and the stream on which the towns to be reached are located 2.5 feet below their present level.

The town of South Kingston, in which the pond is located and which would be most benefited, had a population in 1895, according to the State Manual, amounting to 5,163, and the gain in five years had been 340, or 72 per year. The district of Narragansett, which would be benefited also, in the same year had a population amounting to 1,250, and the loss in five years had been 158, or practically 32 per year.

I do not think the locality worthy of improvement, as the cost of any improvement would be entirely out of proportion to the benefits conferred, and which would be local rather than national. In 1873 a survey of the pond was ordered by Congress and was made under the direction of Maj. G. K. Warren, Corps of Engineers, but adversely reported on by him on the ground that the cost of any improvement that would be useful would be, in his opinion, so great that the amount of commerce to be benefited would not justify the expenditure. Again, in 1888, Maj. W. R. Livermore, Corps of Engineers, reported the locality as not worthy of improvement. In 1892 a third examination was made, by Captain Bixby, Corps of Engineers, who stated in his report that

the improvement of this locality would be principally of local benefit, and gave it as his opinion, in which Colonel Abbot, Corps of Engineers, Division Engineer northeast division, concurred, that this locality is decidedly not at present worthy of improvement by the General Government.

The cost of maintaining an entrance into the pond is uncertain; heavy southerly storms may create a bar at the mouth into the ocean, besides drifting sands have a tendency to shoal up the whole southern end of the pond generally. This is going on all the time and is gradually raising the marsh that in earlier times separated the open water of the pond from the ocean.

The upper part of the pond and the passage leading from it to the towns above will freeze over in severe or ordinarily severe winters, so that continuous navigation, leaving out of consideration the violent storms to which the locality is subject, can not be assured.

Any commercial statistics as regards this special locality, to be affected by any improvements, would be in the main a matter of conjecture.

Point Judith Pond is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last calendar year was $190.45. The nearest light-house is Point Judith Light. The nearest fortification is the fort on Dutch Island, Rhode Island.

Very respectfully, your obedient servant,

D. W. LOCKWOOD,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

APPENDIX D.

IMPROVEMENT OF RIVERS AND HARBORS IN CONNECTICUT, OF PAWCATUCK RIVER, RHODE ISLAND AND CONNECTICUT, AND OF CONNECTICUT RIVER, MASSACHUSETTS AND CONNECTICUT.

REPORT OF MAJ. SMITH S. LEACH, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1898, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Pawcatuck River, Rhode Island and Connecticut.
2. Stonington Harbor, Connecticut.
3. Mystic River, Connecticut.
4. Thames River, Connecticut.
5. Connecticut River below Hartford, Connecticut.
6. Harbor of refuge at Duck Island Harbor, Connecticut.
7. New Haven Harbor, Connecticut.
8. Breakwaters at New Haven, Connecticut.
9. Housatonic River, Connecticut.
10. Bridgeport Harbor, Connecticut.
11. Saugatuck River and Westport Harbor, Connecticut.
12. Norwalk Harbor, Connecticut.
13. Five-mile River Harbor, Connecticut.
14. Stamford Harbor, Connecticut.
15. Harbor at Coscob and Mianus River, Connecticut.
16. Greenwich Harbor, Connecticut.

SURVEYS.

17. Connecticut River, between Hartford, Conn., and Holyoke, Mass.
18. South Norwalk Harbor, Connecticut.

UNITED STATES ENGINEER OFFICE,
New London, Conn., July 26, 1898.

GENERAL: I have the honor to transmit herewith annual report * * * upon the works of river and harbor improvements in my charge for the fiscal year ending June 30, 1898. * * *

Very respectfully, your obedient servant,

SMITH S. LEACH,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

D 1.

IMPROVEMENT OF PAWCATUCK RIVER, RHODE ISLAND AND CONNECTICUT.

The present approved project, that of 1895, provides for a channel of 10 feet depth at mean low water from Stonington Harbor to Westerly, with a width of 200 feet from Stonington, Conn., to Avondale, R. I., a

distance of 4 miles; a width of 100 feet from Avondale to the lower wharves of Westerly, a distance of 2.75 miles, and a width of 40 feet between the upper and lower wharves of Westerly, a distance of 0.5 mile, at a total estimated cost of $200,361.60.

Under the appropriation of $15,000 in act of June 3, 1896, and in pursuance of the programme of work approved for 1896 and 1897, contracts were entered into with Simon C. Fraser and the Hartford Dredging Company, the lowest bidders, for the removal of about 400 cubic yards of rock and bowlders and for dredging 30,000 cubic yards, respectively. Mr. Fraser began April 1, 1897, and work under this contract was in progress at the beginning of the fiscal year. The contract was completed on September 13; 57.55 cubic yards of rocks were removed this year, making the total amount under the contract 323.55 cubic yards. Most of the rocks were taken from the channel at a point two-thirds of the way down from the upper to the lower end of the wharves at Westerly, or opposite Cottrell's wharf.

Work under contract with the Hartford Dredging Company was commenced on July 26. The contract was extended, and completed on December 24, 1897. Thirty-four thousand nine hundred and eighty cubic yards of sand, gravel, and stones and 56.14 tons of large bowlders were removed under this contract, completing the 10-foot channel of 40 feet width opposite the wharves and 1,800 linear feet of the channel 100 feet wide below the wharves, making the total length of the completed channel, of 10 feet depth at mean low water, 4,200 feet.

Pawcatuck River is in the collection districts of Providence and Stonington, the dividing line passing through the river. Providence and Stonington are the nearest ports of entry. The nearest light-houses are the Stonington and Watch Hill lights. The nearest fortification is Fort Trumbull, New London, Conn.

Money statement.

July 1, 1897, balance unexpended	$13,029.05
June 30, 1898, amount expended during fiscal year	12,586.18
July 1, 1898, balance unexpended	442.87
Amount (estimated) required for completion of existing project	185,361.60
Amount that can be profitably expended in fiscal year ending June 30, 1900	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

AMOUNTS APPROPRIATED.

For Pawcatuck River, Rhode Island and Connecticut.

March 3, 1871	$10,000.00	September 19, 1890	$16,600.00
June 10, 1872	10,000.00	July 13, 1892	3,800.00
March 3, 1873	10,000.00	August 18, 1894	6,000.00
June 23, 1874	10,000.00	June 3, 1896	15,000.00
March 3, 1875	10,000.00		
August 5, 1886	12,000.00	Total	113,400.00
August 11, 1888	10,000.00		
December 5, 1895, unexpended balance deposited to credit of the United States Treasurer			399.99
Total			113,000.01

For Little Narragansett Bay, Rhode Island and Connecticut.

August 14, 1876	$5,000.00	March 3, 1881	$5,000.00
June 18, 1878	10,000.00	August 2, 1882	6,000.00
March 3, 1879	5,000.00		
June 14, 1880	5,000.00	Total	36,000.00

Abstract of proposals for dredging in Pawcatuck River, Rhode Island and Connecticut, opened by Maj. Smith S. Leach, Corps of Engineers, February 26, 1897.

[30,000 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
		Cents.	
1	Thomas A. Scott, New London, Conn	27	$8,100.00
a2	Hartford Dredging Co., Hartford, Conn	23	6,900.00
3	James S. Rogers, Plattsburg, N. Y		
4	Simon C. Fraser, New London, Conn	35	10,500.00
5	John P. Randerson, Albany, N. Y	32	9,600.00
6	Frank Pidgeon, Saugerties, N. Y	63	18,900.00
7	Alonzo E. Smith, Islip, N. Y	39.9	11,970.00

a Accepted.

Abstract of proposals for removal of rock from Pawcatuck River, Rhode Island and Connecticut, opened by Maj. Smith S. Leach, Corps of Engineers, February 26, 1897.

[Removal 400 cubic yards or 800 gross tons.]

No.	Name and address of bidder.	Price per cubic yard or ton.	Total.
1	Thomas A. Scott, New London, Conn ..... per ton	$6.00	$4,800.00
2	Hartford Dredging Co., Hartford, Conn ..... do	6.25	5,000.00
3	James S. Rogers, Plattsburg, N. Y ..... per cubic yard	9.80	3,920.00
a4	Simon C. Fraser, New London, Conn ..... do	9.50	3,800.00
5	John P. Randerson, Albany, N. Y ..... per ton	21.00	16,800.00
6	Frank Pidgeon, Saugerties, N. Y ..... per cubic yard	11.00	4,400.00
7	Alonzo E. Smith, Islip, N. Y ..... per ton	6.00	4,800.00

a Accepted.

Contract in force for dredging in Pawcatuck River, Rhode Island and Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
Simon C. Fraser	Mar. 15, 1897	Apr. 16, 1897	July 26, 1897	a Sept. 1, 1897

a Extended to December 31, 1897.

Contract in force for removal of rock from Pawcatuck River, Rhode Island and Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
Simon C. Fraser	Mar. 12, 1897	Mar. 24, 1897	Apr. 15, 1897	Sept. 1, 1897

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1897.

The commerce arriving and leaving Pawcatuck River, Rhode Island, by water during the calendar year ending December 31, 1897, is estimated as follows (based mainly upon reports received from Messrs. Maxson & Co., Westerly, R. I.):

Class of goods.	Tons.
Grains	1,920
Fish, oysters, etc	125
Lumber and products	4,660
Coal, minerals, and products	33,839
Fertilizers	400
Iron	1,430
Sundries	1,200
Sand and stone	2,450
Total	46,024

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
		Feet.	*Tons.*
Steam:			
Freight, mainly	8	7½	200
Passenger, mainly	80	5½	60
Tugs	730	6	45
Sail:			
Freight	290	8½	175
Fishing boats	1,900	2½	9
Pleasure boats, large	1,200	2½	6
Pleasure boats, small	800	2	3
Total	5,008		

The above figures show an increase in tonnage of freights of 6,938 tons over the amounts reported for 1886. Thirteen vessels loaded with lumber for Westerly were obliged to discharge at Stonington owing to lack of water in the river.

New transportation companies established during the year, none.

D 2.

HARBOR OF REFUGE AT STONINGTON, CONNECTICUT.

The present project, that of 1880 with subsequent additions, provides for an eastern breakwater as a protection to the outer harbor; this breakwater, about one-half mile long, to extend from the vicinity of Bartletts Reef to the vicinity of Middle Ground Shoal, or until sufficient protection against southerly winds shall be obtained. The estimated cost was from $143,000 to $191,000, according to length. This did not include foundation for light-house at west end of breakwater.

The project also provides for dredging a channel across Noyes Shoal and for building a dike or water break around Stonington Point.

During the fiscal year no work has been done in furtherance of this project.

A light has been maintained on west end of uncompleted east breakwater.

Stonington Harbor is in the Stonington collection district and is a port of entry. The principal value of the harbor is as a harbor of refuge. The nearest lights are Stonington Light and Latimer Reef Light. The nearest fortification is Fort Trumbull, New London Harbor, Connecticut.

Money statement.

July 1, 1897, balance unexpended	$2,493.16
June 30, 1898, amount expended during fiscal year	948.71
July 1, 1898, balance unexpended	1,544.45

AMOUNTS APPROPRIATED.

March 2, 1827 (survey)	$200.00	August 2, 1882	$25,000.00
May 23, 1828	20,000.00	July 5, 1884	10,000.00
April 23, 1830	16,491.67	August 5, 1886	20,000.00
June 27, 1834	262.16	August 11, 1888	8,000.00
March 3, 1873	25,000.00	September 19, 1890	12,500.00
June 23, 1874	20,000.00	July 13, 1892	12,500.00
March 3, 1875	25,000.00	August 18, 1894	5,000.00
June 18, 1878	40,000.00	June 3, 1896	5,000.00
March 3, 1879	37,500.00		
July 14, 1880	25,000.00	Total	337,453.83
March 3, 1881	30,000.00		

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1897.

These statistics have been asked for, but have not been received. The last report received was for 1896, as follows:

The commerce arriving at and leaving Stonington Harbor, Connecticut, is estimated as follows (based mainly upon reports received from Mr. C. B. Crandall, collector of customs, Stonington, Conn., and others):

Class of goods.	Tons.
Grains and forage	1,200
Fish, oysters, etc	275
Lumber and products	10,000
Coal, minerals, and products	78,000
Fertilizers	175
General merchandise	240,000
Sundries	20,000
Total	349,650

The vessels entering and leaving this waterway are as follows (each entrance and departure together being counted as one):

Character or class of service.	Number.	Average draft.	Average tonnage.
Steam:		*Feet.*	*Tons.*
Freight and passenger	450	12	1,500
Freight mainly	65	10	1,000
Passenger mainly	800	7	35
Fishing	75	7	35
Tugs	175	8	50
Sail:			
Freight	1,000	9	120
Fishing boats	500	6	20
Pleasure boats, small	1,200	2½	7
Total	4,265	.....	.....

The above figures show an increase of 26,836 in tonnage over the report of 1895, which was 322,814 tons.

No new transportation companies have been established during the year.

D 3.

IMPROVEMENT OF MYSTIC RIVER, CONNECTICUT.

The present approved project for this improvement, adopted in 1890, contemplates dredging to make the channel 15 feet deep at mean low water and 100 feet wide for a length of about 4 miles and the reduction of the curvature of five bends, at an estimated cost of $30,000.

Under appropriation of June 3, 1896, at the close of the fiscal year 1897 a contract was in force with Mr. J. P. Randerson, dated January 14, 1897, for dredging 20,000 cubic yards at 10.7 cents per cubic yard.

Dredging under this contract was commenced on September 25 and completed on October 21, 1897. Twenty-five thousand and eighty-eight cubic yards of mud were removed at the lower or fifth bend, which is at the mouth of the channel nearly opposite Palmer's shipyard. Two cuts were made on the east side of the bend, widening it 50 feet for a length of 1,200 feet.

Mystic River is in the New London collection district, of which New London is the port of entry. The nearest work of defense is Fort Griswold, New London Harbor, about 6 miles west. There is a light-house on Morgan Point, on the west side of the river at its mouth.

Money statement.

July 1, 1897, balance unexpended	$3,268.21
June 30, 1898, amount expended during fiscal year	2,921.32
July 1, 1898, balance unexpended	346.89
Amount (estimated) required for completion of existing project	3,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

Appropriations for the improvement of Mystic River, Connecticut, have been made as follows:

Application.	Date.	Amount.
Dredging above and just below railroad bridge and at the mouth of the river	Sept. 19, 1890	$10,000
Dredging below the railroad bridge	July 13, 1892	10,000
Dredging opposite Noank	Aug. 17, 1894	3,500
Dredging at the mouth of the river	June 3, 1896	3,500
Total		27,000

Abstract of proposals for dredging in Mystic River, Connecticut, opened by Capt. Smith S. Leach, Corps of Engineers, December 23, 1896.

[Estimated yardage, 20,000 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
		Cents.	
1a	John P. Randerson, Albany, N. Y	10⅞	$2,175.00
2	Newburg Dredging Co., Newburg, N. Y	14	2,800.00
3	Wm. H. Taylor, jr., Jersey City, N. J	11 3/10	2,360.00
4	Simon C. Fraser, New London, Conn	13½	2,700.00
5	T. A. Scott, New London, Conn	13	2,600.00
6	Hartford Dredging Co., Hartford, Conn	11½	2,300.00
7	Columbian Dredging Co., Fall River, Mass	13 7/10	2,740.00

a Accepted.

Contract in force for dredging in Mystic River, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
John P. Randerson	Jan. 14, 1897	Feb. 3, 1897	Sept. 25, 1897	Dec. 31, 1897

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1897.

Arrival and departure of vessels.

AT MYSTIC.

[Draft 5 to 16 feet; tonnage 100 to 600 tons.]

Kind of vessel.	Number of round trips.	Aggregate tonnage of all trips.
Sailing vessels	49	13,767
Steamers, excursion steamers, and tugboats	242	
Barges, scows, etc	9	7,800
Total	300	21,567

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Coal	6,800	$34,000
Lumber (8,011,393 feet)	12,017	160,227
Silex	450	18,000
Miscellaneous	2,300	43,000
Total	21,567	255,227

The above figures show a decrease of tonnage since the last record received (for 1896) of 4,313 tons.

No new lines of transportation established during the year.

AT NOANK, MOUTH OF RIVER.

[Through courtesy of Robert Palmer & Son.]

33 new vessels built and launched, combined tonnage	17,464
29 vessels repaired (8 steamers, 17 sailing, 4 barges)	16,916
150 tugboats arrived and departed	5,000
7,711,393 feet of lumber received	10,188
Other tonnage, estimated	2,000
Total	51,568

These figures (51,568 tons) include those only that have had business at the shipyard. Other small vessels have been here of which no record has been made.

The above figures show an increase of 5,066 tons over those received for 1896.

D 4.

IMPROVEMENT OF THAMES RIVER, CONNECTICUT.

The present project for improving Thames River is that of 1866, with subsequent modifications, and consists in making and maintaining by dredging and a system of training walls a channel 200 feet wide from New London to Norwich, to be 16 feet deep at mean low water up to Allyn Point (about 5 miles below Norwich), and thence to Norwich to be 14 feet deep, together with dredging in Shaws Cove, New London Harbor, to make and maintain a channel 100 feet wide and 12 feet deep and an anchorage basin of the same depth and of about 7½ acres area. The estimated cost from the beginning, in 1866, is $457,600.

At the beginning of the year a contract with the Newburg Dredging Company for dredging about 60,000 cubic yards of material, at 14 cents per yard, under the appropriation in act of June 3, 1896, was in force. Work under this contract was commenced on July 16 and completed on September 21, 1897. Sixty thousand four hundred and forty-six cubic yards of sand were removed. The 14-foot channel was extended 1,200 feet with width of 100 feet in front of the New York and New England Railroad dock at Norwich, the upper end terminating in the deep hole at the mouth of the Shetucket River near the steamboat dock. The channel was also widened from 25 to 50 feet below the railroad dock and at Thamesville, the widening being altogether about a mile in length. The channel at Fort Point was also widened for the benefit of navigation to the dock there. A large bowlder was removed from the channel in front of the New York and New England Railroad dock, upon which the contractor worked 1⅓ hours at $10 per hour.

The Thames River is in the collection district of New London. The nearest lighthouse is at the mouth of the river, on the west shore. Forts Trumbull and Griswold overlook the mouth of the river from either shore.

Money statement.

July 1, 1897, balance unexpended	$12,024.66
June 30, 1898, amount expended during fiscal year	9,958.85
July 1, 1898, balance unexpended	2,065.81
Amount (estimated) required for completion of existing project	69,100.00
Amount required for maintenance annually	8,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	40,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

Appropriations for improving Thames River, Connecticut, have been made as follows:

Application.	Date.	Amount.
For previous projects:		
Removal of obstructions placed during the war of 1812	Mar. 3, 1821	$150
Survey	Mar. 2, 1829	150
Piers and dredging	July 4, 1836	10,000
Do	July 7, 1838	10,000
Do	Mar. 3, 1837	20,000
Total		40,300
For the present project:		
Dredging and survey	June 23, 1866	10,000
Dredging	Mar. 3, 1867	72,000
Do	Mar. 3, 1871	15,000
Do	June 10, 1872	10,000
Do	June 18, 1878	10,000
Do	Mar. 3, 1879	12,000
Do	June 14, 1880	22,500
Dredging and training walls	Mar. 3, 1881	30,000
Training walls	Aug. 2, 1882	35,000
Do	July 5, 1884	25,000
Training walls and dredging	Aug. 5, 1886	22,500
Repairs of training walls and dredging	Aug. 11, 1888	50,000
Dredging	Sept. 19, 1890	20,000
Do	July 13, 1892	30,000
Do	Aug. 18, 1894	12,500
Do	June 3, 1896	12,000
Total		388,500
Total amount appropriated since 1821		428,800

Abstract of proposals for dredging in the Thames River, Connecticut, opened by Capt. Smith S. Leach, Corps of Engineers, December 23, 1896.

[Estimated yardage, 60,000 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
		Cents.	
1	John P. Randerson, Albany, N. Y	14½	$8,550
a 2	Newburg Dredging Co., Newburg, N. Y	14	8,400
3	Emory R. Seward, Albany, N. Y	23½	14,100
4	Elijah Brainard, New York, N. Y	15 9/10	9,540
5	Hartford Dredging Co., Hartford, Conn	16½	9,900
6	R. G. & J. F. Packard, New York, N. Y	23½	14,100

a Accepted.

Contract in force for dredging in Thames River, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
Newburg Dredging Co	Jan. 11, 1897	Feb. 10, 1897	July 16, 1897	Dec. 31, 1897

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1897.

Arrivals and departures of vessels.

AT SHAWS COVE, NEW LONDON HARBOR.

[Draft, 6 to 14 feet; tonnage, 10 to 300 tons.]

Kind of vessel.	Number of round trips.	Aggregate tonnage of all trips.
Steamers (tugboats)	58	.....
Sailing vessels	29	5,694
Total	87	5,694

The above does not include 10 schooners, 10 yachts, and 4 steamers laid up for the winter.

Kind of freight.	Tons.	Value.
Coal, lumber, brick, and cast-iron pipe	5,694	$33,830

THAMES RIVER AT ALLYN POINT AND NORWICH.

[Draft, 5 to 19 feet; tonnage, 100 to 1,900 tons.]

Kind of vessel.	Number of round trips.	Aggregate tonnage of all trips.
Sailing vessels	125	55,900
Steamers, excursion boats, and tugboats	1,200	15,000
Barges, scows, etc	350	298,130
Total	1,675	369,030

Freight received and shipped by water.

Chief articles.	Tons.
Coal	327,980
Lumber	18,000
Miscellaneous	23,050
Total	369,030

The above record does not include the commerce of New London Harbor, which is reported as 786,341 tons, and outside of Shaws Cove can not be said to be directly benefited by the improvement.

In 1896, 405,845 tons was reported, which shows a decrease of 36,815 tons for 1897. This decrease is said to be due to all-rail transportation.

No new lines of transportation have been established during the year.

D 5.

IMPROVEMENT OF THE CONNECTICUT RIVER BELOW HARTFORD, CONNECTICUT.

The approved project for improving Connecticut River includes the construction of converging jetties at the mouth, and dredging to open and maintain a channel between them, and the maintenance of channels

100 feet wide and 9 feet deep at extreme low water across the bars below Hartford by dredging and construction of dikes at Hartford and Glastonbury, at an estimated cost of $130,000 for permanent work and $10,000 per year for annual dredging.

Appropriations of late years have been $20,000, the amount required for two years' dredging, and no progress has been made on the permanent works, nor has the jetty channel been fully developed. This channel, now about 130 feet wide and 12 feet deep, should be widened, though possibly not to the projected width of 400 feet.

The jetties were never completed, and the deterioration by settlement and wave attack has reduced them to a condition urgently requiring attention. At least 10,000 tons of stone should be placed on them at once, and the Hartford Dike should be repaired. The Glastonbury Dike needs no repairs.

At the beginning of the fiscal year the annual dredging was in progress under a contract with the Hartford Dredging Company, dated March 15, 1897, for the removal of about 100,000 cubic yards of material at 9 cents per yard, and on June 30, 21,316 cubic yards of material had been removed, as follows:

	Cubic yards.
From Hartford Bar	21,038
From Clay Banks Bar	278

Dredging under this contract was continued until October 15, 1897, and completed on that date, all necessary dredging for the season having been accomplished and the channel left with the projected depth and widths of about 60 feet, sufficient only for the immediate needs of navigation. The amount of material removed during the past fiscal year under this contract was 77,909 cubic yards, divided as follows:

From—	Cubic yards.
Hartford Bar	13,149
Clay Banks Bar	2,119
Press Barn Bar	20,500
Glastonbury Bar	16,742
Dividend Bar	10,289
Pistol Point Bar	4,756
Sears Shoal Bar	7,228
Portland Bar	3,126
Total, July 1 to October 15, 1897	77,909

The total amount of material removed under this contract was 99,225 cubic yards. Six hundred and sixty-six yards of the material dredged was hard clay, for which the contractors were paid 50 per centum more than the price for ordinary material. The contractors were also paid $36 for towing from bar to bar four and one-half hours during working hours, and $108 for inspector's board at the rate of $4.50 per week, all of the above being under the terms of the contract.

Under the unexpended balance of the appropriation of 1896 bids were opened on May 6, 1898, for work this season, and a contract, dated May 21, 1898, entered into with the Hartford Dredging Company, the lowest bidders, for removing about 100,000 cubic yards of material, at 7.8 cents per yard. Under this contract dredging was commenced on May 23, and continued to the close of the fiscal year, at which time 32,594 cubic yards of material were removed as follows:

From—	Cubic yards.
Pistol Point Bar	4,806
Hartford Bar	20,559
Clay Banks Bar	7,229
Total	32,594

The total amount of material removed during the past fiscal year was 110,503 cubic yards.

The Connecticut River is in the collection district of Hartford. There is a lighthouse on Saybrook Point, on the west shore of the river at its mouth, and another at the end of the west jetty, besides which there are three small beacon lights and several range lights in the river which are maintained by the United States. Fort Trumbull, New London Harbor, Conn., about 16 miles east of Saybrook Point, is the nearest work of defense.

Money statement.

July 1, 1897, balance unexpended		$19,924.39
June 30, 1898, amount expended during fiscal year		10,395.32
July 1, 1898, balance unexpended		9,529.07
July 1, 1898, outstanding liabilities	$2,542.33	
July 1, 1898, amount covered by uncompleted contracts	5,257.67	
		7,800.00
July 1, 1898, balance available		1,729.07

Amount (estimated) required for completion of existing project	130,000.00
Amount (estimated) required for maintenance annually	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

Appropriations for improving the Connecticut River below Hartford have been made as follows:

Application.	Date.	Amount.
Dredging at Saybrook Bar	July 4, 1836	$20,000.00
Dredging at Saybrook Bar (the unexpended balance of 1836 reappropriated)	Mar. 3, 1839	.....
Balance due contractor under previous appropriation	Mar. 1, 1843	3,471.57
Dredging at Pratts Ferry, Pistol Point, Mouse Island; piling at Hartford	July 11, 1870	20,000.00
Dredging at Hartford, Clay Banks, Pier I, Pier J, Pratts Ferry, Glastonbury, Pistol Point, and Chester Rock	Mar. 3, 1871	35,000.00
Dredging at Pratts Ferry, Pistol Point, and Saybrook jetty	June 10, 1872	40,000.00
Dredging at Hartford, Pratts Ferry, Glastonbury, and Saybrook jetty	Mar. 3, 1873	20,000.00
Dredging at Hartford, Pratts Ferry, Saybrook, Saybrook jetties	June 23, 1874	20,000.00
Dredging at Hartford, Pratts Ferry, Glastonbury, Saybrook jetties	Mar. 3, 1875	20,000.00
Dredging at Hartford, Pratts Ferry, Glastonbury, Saybrook jetties, Salmon River dredging	Aug. 14, 1876	20,000.00
Compensation for previous dredging	—— 1878	4,203.00
Saybrook jetties, survey from Hartford to Rocky Hill	June 18, 1878	30,000.00
Dredging at Hartford, Press Barn, Glastonbury	Mar. 3, 1879	10,000.00
Dredging at Hartford, Glastonbury, and Saybrook jetties	June 14, 1880	10,000.00
Dredging at Hartford, Pratts Ferry, Glastonbury, Glastonbury wing dam, Saybrook jetties	Mar. 3, 1881	30,000.00
Dredging at Hartford, Clay Banks, Pratts Ferry, Press Barn, Glastonbury, Dividend, Pistol Point, and Salmon River, Hartford dike	Aug. 2, 1882	45,000.00
Dredging at Hartford, Clay Banks, Pratts Ferry, Press Barn, Glastonbury, Dividend, Pistol Point, Mouse Island, and between Saybrook jetties, extending west jetty at Saybrook	July 5, 1884	35,000.00
Compensation for previous dredging	Mar. 3, 1885	4,745.43
Dredging at Hartford, Clay Banks, Naubuc, Press Barn, Glastonbury, Dividend, Pistol Point, and Haddam Island; repairs of Hartford dike and Saybrook jetties	Aug. 5, 1886	26,350.00
Annual dredging at Hartford, Clay Banks, Press Barn, Glastonbury, Dividend, Brockways	Aug. 12, 1888	10,000.00
Annual dredging at Hartford, Clay Banks, Press Barn, Glastonbury, Dividend, Pistol Point, Mouse Island, Haddam Island	Sept. 19, 1890	12,500.00
Annual dredging at Hartford, Clay Banks, Naubuc, Press Barn, Glastonbury, Dividend, Pistol Point, Mouse Island, Sears Shoal, Chester Rock, Devils Reef, Calves Island	July 13, 1892	20,000.00
Annual dredging upon several bars below Hartford, in progress	Aug. 18, 1894	20,000.00
Do	June 3, 1896	20,000.00
Total	.....	476,170.00

Abstract of proposals for dredging in Connecticut River, Connecticut, opened by Maj. Smith S. Leach, Corps of Engineers, February 26, 1897.

[Estimated yardage, 100,000 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
		Cents.	
1	Alonzo E. Smith, Islip, N. Y.	12½	$12,500.00
2	John P. Randerson, Albany, N. Y.	10¼	10,250.00
3	Frank Pidgeon, Saugerties, N. Y.	13 3/15	13,900.00
4	Hartford Dredging Co., Hartford, Conn.	9	a 9,000.00
5	Newburg Dredging Co., Newburg, N. Y.	9½	9,500.00

a Accepted.

Contract in force for dredging in Connecticut River, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
Hartford Dredging Co.	Mar. 15, 1897	Apr. 16, 1897	June 9, 1897	.....

Abstract of proposals for dredging in Connecticut River, Connecticut, opened by Maj. Smith S. Leach, Corps of Engineers, May 6, 1898.

[Estimated quantity to be dredged, about 100,000 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
		Cents.	
1	John P. Randerson, Albany, N. Y.	8	$8,000.00
2	Hartford Dredging Co., Hartford, Conn.	7 2/15	a 7,800.00
3	Edward F. Dailey, Brooklyn, N. Y.	14¾	14,375.00
4	Morris & Cumings Dredging Co., New York	15	15,000.00

a Accepted.

Contract in force June 30, 1898, for dredging in Connecticut River, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
Hartford Dredging Co.	May 21, 1898	June 15, 1898	May 23, 1898	.....

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1897.

[Through courtesy of Mr. C. C. Goodrich, general manager of the Hartford and New York Transportation Company.]

Arrivals and departures of vessels.

[Draft, 6 to 12 feet; tonnage, 100 to 1,600 tons.]

Kind of vessel.	Number of round trips.	Aggregate tonnage of all trips.
Steamers, estimated	400	800,000
Sailing vessels, estimated	250	
Barges, estimated	700	
Total	1,350	800,000

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Receipts:		
Coal, estimated	350,000	$35,000,000
Stone, estimated	60,000	
Miscellaneous goods, estimated	18,000	
Shipments:		
Stone, estimated	80,000	10,500,000
Wood, lumber, etc., estimated	55,000	
Miscellaneous goods, estimated	85,000	
Total receipts and shipments	648,000	45,500,000

These figures show an increase in tonnage of freights of 38,000 tons over that reported for 1896.

No new lines of transportation established during the fiscal year.

The above is a close estimate, as three-fourths of the amounts above are taken from records of this company, who do nearly that percentage of work and do towing for most of the remaining one-fourth.

The work of the Government in improving navigation has been of most satisfactory character, cargoes having increased in size in fifteen years from an average of 200 tons each to an average of 600 tons each, some cargoes going as high as 1,300 tons. The usual dredging must be done each year and dike at Hartford Bar should be raised 4 to 5 feet.

D 6.

IMPROVEMENT OF HARBOR OF REFUGE AT DUCK ISLAND, CONNECTICUT.

The project for this improvement consists in building three breakwaters, aggregating 5,880 feet in length, at an estimated cost of $463,540. At the beginning of the fiscal year 2,385 feet of the west breakwater had been built. Work upon the others has not been commenced.

On June 30, 1897, a contract with J. Frank Quinn, dated November 20, 1896, was in force for the delivery of 25,000 tons of stone in the west breakwater, at 65 cents per ton. This contract expired by limitation on August 27, 1897, no steps having been taken to execute same, and no application having been made for an extension of time. It was recommended by the Chief of Engineers, and approved by the Secretary of War, that the contract be annulled and the work readvertised, and upon completion of a new contract that suit be brought against the contractor and his bondsmen for any sum in excess of the amount named in Mr. Quinn's contract expended for the work under the new contract.

On October 25, 1897, proposals for this work were opened, and a contract was subsequently made with Mr. John Beattie, of Leete Island, Conn., for the delivery of about 25,000 tons of riprap, at the rate of 77 cents per ton.

Work under this contract was commenced on November 8, 1897, and was in progress and nearly completed at the close of the fiscal year. Twenty thousand nine hundred and thirty-five tons of stone have been delivered under this contract, and the west breakwater has been extended 370 linear feet. Three hundred and eighty linear feet of work built under preceding contract and which had settled has been repaired. Nineteen thousand four hundred and seventeen tons of stone were used in the extension and 1,518 tons in the repairs. During the

fiscal year a small light has been maintained on the west end of the uncompleted breakwater.

The breakwater extending westerly from Duck Island, with a projected length of 3,000 feet, is now 2,755 feet in length and contains 117,823 tons of stone. It terminates in 17 feet of water at low tide on very soft mud bottom, and settlement is to be expected.

Duck Island is in the collection district of Hartford. The nearest light-house is at Saybrook Point, at the mouth of the Connecticut River, about 8 miles eastward. There is a light vessel on Long Sand Shoal, about 5 miles to the southeast. Fort Trumbull, New London Harbor, 21 miles east, is the nearest work of defense.

Money statement.

July 1, 1897, balance unexpended		$22,326.55
June 30, 1898, amount expended during fiscal year		15,434.78
July 1, 1898, balance unexpended		6,891.77
July 1, 1898, outstanding liabilities	$3,423.28	
July 1, 1898, amount covered by uncompleted contracts	2,883.65	
		6,306.93
July 1, 1898, balance available		584.84
Amount (estimated) required for completion of existing project		349,540.00
Amount that can be profitably expended in fiscal year ending June 30, 1900		50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.		

Appropriations for harbor of refuge at Duck Island Harbor, Connecticut, have been made as follows:

Application.	Date.	Amount.
Westerly breakwater:		
946 feet	Sept. 19, 1890	$25,000
714 feet	July 13, 1892	35,000
725 feet and repairs	Aug. 17, 1894	30,000
Westerly breakwater (contract in progress)	June 3, 1896	24,000
Total		114,000

Abstract of proposals for constructing breakwater at Duck Island, Connecticut, opened by Capt. Smith S. Leach, Corps of Engineers, October 28, 1896.

[Estimated tonnage, 25,000 tons.]

No.	Name and address of bidder.	Price per gross ton.	Total.
1	S. & E. S. Belden, Hartford, Conn	$0.93	$23,250.00
2	J. Frank Quinn, New York, N. Y	.65	a 16,250.00
3	John J. Shipman, Washington, D. C	1.40	35,000.00

a Accepted.

Contract in force for constructing breakwater at Duck Island, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
J. Frank Quinn a	Nov. 20, 1896	Dec. 5, 1896		Aug. 25, 1897

a Failed to commence. Contract expired by limitation.

Abstract of proposals for constructing breakwater at Duck Island, Connecticut, opened by Maj. Smith S. Leach, Corps of Engineers, October 25, 1897.

[Estimated quantity, 25,000 gross tons.]

No.	Name and address of bidder.	Price per gross ton.	Total.
		Cents.	
1	Andrew A. Bouker, New York, N. Y.	91	$22,750
2	Daniel Toomey, Guilford, Conn	79¼	19,875
a3	John Beattie, Leete Island, Conn.	77	19,250
4	S. & E. S. Belden, Hartford, Conn.	79	19,750

a Accepted.

Contract in force June 30, 1898, for constructing breakwater at Duck Island, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
John Beattie	Nov. 6, 1897	Nov. 22, 1897	Nov. 8, 1897	July 22, 1898

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1897.

These statistics have been asked for, but have not been received. The last report received was for 1896, as follows:

No record of the number of vessels passing this harbor of refuge is kept. It is believed to be approximately two-thirds of the number passing the New Haven breakwater, which is reported as 151,356 for the year 1895.

During the twelve months up to July 1, 1897, a record has been kept of the number of vessels observed at anchor behind the Duck Island breakwater, which is as follows:

Schooners	124	Barges and canal boats	24
Sloops	6	Steamers	4
Yachts	15	Pile driver	1
Towboats	8		
Fleet of barges in tow	1	Total	188
Steam barges	5		

D 7.

IMPROVEMENT OF NEW HAVEN HARBOR, CONNECTICUT.

The present project for this work, now approaching completion, provides for a dredged channel 16 feet deep at mean low water, 400 feet wide from the Sound across Fort Hale Bar, a distance of 1¼ miles, and 400 to 700 feet wide from the upper side of the bar to the head of the harbor, 2 miles, at an estimated cost of $348,000.

A dike has also been built to aid in the development of the channel across the bar. This project now lacks to complete it only the widening of the Fort Hale cut from 200 to 400 feet.

At the beginning of the fiscal year a contract, dated January 7, 1897, was in force with William H. Taylor, jr., the lowest bidder, for dredging 90,000 cubic yards in the Fort Hale channel, at 5 cents per cubic yard, work to be completed by December 31, 1897.

Dredging under this contract was commenced on August 10, 1897, and completed on October 11, 1897, 98,000 cubic yards of soft mud having

been removed. The 16-foot channel across Fort Hale Bar, 6,560 feet long and 100 feet wide, was widened 100 feet, making it 200 feet wide.

New Haven, the port of entry for the collection district of New Haven, is situated at the head of New Haven Harbor, about 3½ miles from Long Island Sound. There is a light-house on Southwest Ledge, at the mouth of the harbor. Fort Trumbull, New London Harbor, 43 miles east, is the nearest work of defense.

Money statement.

July 1, 1897, balance unexpended	$9,226.86
June 30, 1898, amount expended during fiscal year	8,663.98
July 1, 1898, balance unexpended	562.88
Amount (estimated) required for completion of existing project	28,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	28,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

Appropriations for the improvement of New Haven Harbor have been made as follows:

Application.	Date.	Amount.
Removal of Middle Rock, not expended until 1867	Aug. 30, 1852	$6,000
Removal of rocks	July 11, 1870	15,000
Dredging (13 feet) above Fort Hale	Mar. 3, 1871	40,000
Dredging (16 feet) Fort Hale Bar, and removal of rocks	June 10, 1872	25,000
Dredging (16 feet) Fort Hale Bar	Mar. 3, 1873	25,000
Dredging (13 feet) above Long wharf	Mar. 3, 1875	10,000
Dredging (16 feet) Long wharf to Fort Hale	June 18, 1878	25,000
Dredging (16 feet) above Long wharf	Mar. 3, 1879	15,000
Do	June 14, 1880	15,000
Dredging (16 feet) Long wharf to Fort Hale	Mar. 3, 1881	15,000
Sandy Point Dike	Aug. 2, 1882	30,000
Dredging (18, 12, and 8 feet) above Long wharf	July 5, 1884	10,000
Sandy Point Dike	Aug. 5, 1886	20,000
Do	Aug. 11, 1888	15,000
Dredging	Sept. 19, 1890	15,000
Do	July 13, 1892	15,000
Dredging (Fort Hale Bar)	Aug. 18, 1894	10,000
Resurvey and dredging	June 3, 1896	10,000
Total		326,000

The first appropriation, $6,000, was applied to a previous project.

Abstract of proposals for dredging in New Haven Harbor, Connecticut, opened by Maj. Smith S. Leach, Corps of Engineers, December 23, 1896.

[Estimated yardage 90,000 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
		Cents.	
a1	William H. Taylor, jr., Jersey City, N. J	8	$7,200
2	William DuBois, New York, N. Y	12	10,800
3	Henry DuBois's Sons, New York, N. Y	8½	7,425

a Accepted.

Contract in force for dredging in New Haven Harbor, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
William H. Taylor, jr	Jan. 7, 1897	Jan. 15, 1897	Aug. 10, 1897	Dec. 31, 1897

COMMERCIAL STATISTICS FOR THE YEAR 1897.

These statistics have been asked for, but have not been received. The last report received was for 1896, as follows:

[Through courtesy of Mr. Henry H. Babcock, collector of customs.]

Foreign.

Value of imports	$265,258
Revenue receipts	58,177
Total	323,435
Foreign vessels:	
Entered	53
Cleared	47
Total	100
Domestic vessels:	
Entered	735
Cleared	730
Total	1,465

Net tonnage of vessels owned at this port.

Steamers	12,234
Sailing vessels	37,257
Barges	17,732
Total	67,323

Arrivals and departures of vessels.

[Draft, 6 to 22 feet; tonnage, 100 to 2,600 tons.]

Kind of vessel.	Number of round trips.	Aggregate tonnage of all trips.
Steamers of all kinds	13,250	2,950,000
Sailing vessels	7,500	4,780,000
Barges in tow, scows, etc	7,900	3,100,000
Total	28,650	10,830,000

Freight received and shipped, coastwise only.

Chief articles.	Tons.	Estimated value.
Coal received and shipped	875,000	$2,960,000
Iron received and shipped	126,000	4,125,000
Lumber received, 74,000,000 feet	121,000	2,100,000
Oysters, received and shipped	72,000	760,000
Miscellaneous merchandise:		
Received	976,000	110,850,000
Shipped	882,000	129,400,000
Total	3,052,000	250,195,000

The above figures show a decrease in tonnage of freight under that reported for the year 1895 of 243,900 tons, which is the result of diminished business occasioned by the depression of the times.

No new lines of transportation have been established since January 1, 1896.

D 8.

CONSTRUCTION OF BREAKWATERS AT NEW HAVEN, CONNECTICUT.

The present project for this work consists in building four breakwaters for a harbor of refuge at the entrance to New Haven Harbor, at an estimated cost of $2,151,134. These breakwaters are designated as follows: The east, the Ludington Rock, the west, and the northeast, with lengths, respectively, of 3,450 feet, 5,000 feet, about 3,000 feet, and 1,200 feet, aggregating 12,650 linear feet. Of the total length of breakwaters contemplated in the project, there have been built to this date the east, 3,450 feet long; 4,500 of the Ludington Rock, and 1,490 feet of the west breakwater, making a total of 9,440 feet, and leaving 3,210 feet to complete. The part built has not the originally proposed section, but no failures have occurred due to that cause, and in the absence of any the reduced section would seem to be sufficient.

The last work on these breakwaters closed on February 1, 1897. Nothing has been done during the fiscal year.

Lights have been and are now maintained on the Ludington Rock and west breakwaters.

New Haven, the port of entry for the collection district of New Haven, is situated at the head of New Haven Harbor, about 4 miles north of the breakwaters.

There is a light-house on Southwest Ledge, the west terminus of the east breakwater.

Fort Trumbull, New London Harbor, 42 miles east, is the nearest work of defense.

Money statement.

July 1, 1897, balance unexpended	$4,123.69
June 30, 1898, amount expended during fiscal year	1,585.48
July 1, 1898, balance unexpended	2,538.21
July 1, 1898, outstanding liabilities	125.00
July 1, 1898, balance available	2,413.21
Amount (estimated) required for completion of existing project	1,316,134.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	200,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

Appropriations for constructing breakwater at New Haven, Conn., have been made as follows:

Application.	Date	Amount.
Easterly breakwater	Mar. 3, 1879	$30,000
Do	June 14, 1880	30,000
Do	Mar. 3, 1881	60,000
Do	Aug. 2, 1882	60,000
Do	July 5, 1884	40,000
Do	Aug. 5, 1886	75,000
Do	Aug. 11, 1888	75,000
Middle or Ludington Rock breakwater	Sept. 19, 1890	120,000
Do	July 13, 1892	120,000
Middle and west breakwaters	Aug. 18, 1894	125,000
West breakwater	June 3, 1896	100,000
Total		835,000

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1897.

These statistics have been asked for, but have not been received. The last statement obtained was for 1895, which was as follows:

Vessels passing New Haven breakwater.

Men-of-war	16
Steamers of all kinds	43,200
Steamships	1,800
Ships, barks, and brigs	1,690
Schooners and sloops of all kinds	54,250
Barges in tow, scows, etc	50,400
Total	151,356

These records are not complete, as some vessels pass unobserved in the night or in thick weather.

During the year past 92 vessels have been observed under and close to the breakwater for refuge, and in the mouth of the harbor, partly under the protection of the breakwaters, 3,925 vessels have been observed.

D 9.

IMPROVEMENT OF HOUSATONIC RIVER, CONNECTICUT.

The present project for this work consists in making and maintaining a channel 7 feet deep at mean low water from Long Island Sound to the head of navigation, about 13 miles, to be 100 feet wide in the river and 200 feet wide over the bar at the mouth, by dredging, removing Drews Rock, building a jetty at Sow and Pigs Reef, a dike at the bend below Stratford, and a breakwater 5,750 feet long to protect the channel over the bar at the mouth of the river, all at an estimated cost of $275,500. Up to July 1, 1897, this project required only the enlargement of the breakwater, a slight extension of the dike, and dredging on the bars to make it complete.

At the beginning of the fiscal year work had just been commenced under a contract with J. P. Randerson, dated March 11, 1897, for dredging about 50,000 cubic yards of material at 23.5 cents per cubic yard, the material to be taken out of the river. Subsequently an agreement was made for placing the material upon the shore above high-water mark at 20 cents per yard. Dredging under this contract was continued to October 23, 1897, and completed on that date.

The total amount of material removed during the fiscal year was 53,355 cubic yards, and that, together with 1,323 cubic yards dredged from Mill Bar the last three days in June, 1897, made the total amount removed under the contract 54,678 yards, of which 49,906 yards were pumped ashore at Oronock, and the remainder, 4,772 yards, was dumped in Long Island Sound. The location of the dredging and amounts of material removed were as follows:

From—	Cubic yards.
Mill Bar	24,192
Oronock Bar	7,926
Camp-Meeting Grounds Bar	5,791
Drews Bar	14,320
Two-Mile Island Bar	2,509
Total, including 1,323 yards dredged in 1897	54,678

Channels of from 75 to 100 feet in width and 7 feet deep at mean low water were made through all the bars where dredging was required above the mouth of the river.

During the fiscal year a small light was maintained on the outer end of the breakwater at the mouth of the river.

The Housatonic River is the boundary between the collection districts of New Haven and Fairfield. The nearest light-house is on Stratford Point, at the mouth of the river. The nearest work of defense is Fort Schuyler, Throgs Neck, about 43 miles to the southwest.

Money statement.

July 1, 1897, balance unexpended	$14,918.37
June 30, 1898, amount expended during fiscal year	13,087.87
July 1, 1898, balance unexpended	1,830.50
Amount (estimated) required for completion of existing project	62,000.00
Amount (estimated) required for annual maintenance	4,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	35,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

Appropriations for improving Housatonic River, Connecticut, have been made as follows:

Application.	Date.	Amount.
Sow and Pigs Jetty, dredging	Mar. 3, 1871	$15,000
Drew Rock Jetty, dredging	June 10, 1872	15,000
Dredging	Mar. 3, 1873	10,000
Do	June 23, 1874	10,000
Do	Mar. 3, 1875	5,000
Do	June 18, 1878	5,000
Do	June 14, 1880	2,000
Do	Mar. 3, 1881	2,000
Removing Drew Rock and Jetty in 1887	Aug. 2, 1882	2,000
Do	July 5, 1884	2,500
Do	Aug. 5, 1886	5,000
Commencing breakwater, dredging	Aug. 11, 1888	35,000
Extending breakwater, dredging	Sept. 19, 1890	35,000
Extending breakwater, dike and dredging	July 13, 1892	20,000
Do	Aug. 18, 1894	25,000
Enlarging breakwater and dredging	June 3, 1896	25,000
Total		212,500

Abstract of proposals for dredging in the Housatonic River, Connecticut, opened by Maj. Smith S. Leach, Corps of Engineers, December 23, 1896.

[Estimated yardage, 50,000 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
		Cents.	
1*a*	John P. Randerson, Albany, N. Y.	23½	$11,750
2	Emory R. Seward, Albany, N. Y.	35	17,500
3	Hartford Dredging Co., Hartford, Conn.	24	12,000

a Accepted.

Contract in force June 30, 1897, for dredging in the Housatonic River, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
John P. Randerson	Jan. 14, 1897	Feb. 13, 1897	June 28, 1897	Dec. 31, 1897

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1897.

[Through courtesy of Capt. John McNeil, harbor master at Bridgeport.]

Arrivals and departures of vessels.

[Draft, 2 to 8 feet; tonnage, 8 to 450 tons.]

Kind of vessel.	Number of round trips.	Aggregate tonnage of all trips.
Steamers of all kinds	934	46,700
Sailing vessels	240	18,750
Barges	209	42,250
Total	1,383	107,700

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Coal	58,500	$270,500
Iron	1,800	21,600
Lumber, 3,000,000 feet	4,500	52,500
Oysters	12,400	67,000
Miscellaneous	5,000	45,000
Total	83,200	456,600

The above figures include the tonnage of the oyster industry at mouth of river but do not include the large number of small vessels which are employed in same. These figures show an increase of 3,553 tons over the tonnage reported for 1896.

No new lines of transportation have been established during the fiscal year.

D 10.

IMPROVEMENT OF BRIDGEPORT HARBOR, CONNECTICUT.

The present project for this work is to make and maintain a channel from Long Island Sound to the head of navigation, to be 15 feet deep at mean low water and 300 feet wide up to the Inner Beacon; thence to the Lower Bridge to be 15 feet deep and 200 feet wide, with increased width of 12 feet depth for anchorage, and with a 12-foot channel 200 feet wide to the causeway at Yellow Mill Pond; above the lower bridge to be 9 feet deep and 100 feet wide; and to protect the channel and harbor by a breakwater from the east shore at the harbor's mouth and one from the Tongue to the Inner Beacon, all at an estimated cost of $385,000.

At the beginning of the fiscal year a contract with George D. Beardsley, dated December 28, 1896, and expiring December 31, 1897, for dredging about 140,000 cubic yards of material at 10 cents per yard, was in force, but work had not been commenced.

Work under this contract was commenced on August 3, 1897, and continued until October 5, 1897, at which time the plant was withdrawn to work on a contract at Five Mile River. Mr. Beardsley finished his contract at Five Mile River, and then resumed work at Bridgeport on December 6. Work was suspended to make alterations to the dredge on December 11, 1897, was resumed on January 7, 1898, and continued to June 18, 1898, upon which date the contract was completed. The contract was twice extended, the last time to July 16, 1898.

One hundred and thirty-seven thousand seven hundred cubic yards of material were removed under this contract during the fiscal year. The work done was to extend the 15-foot channel, with width of 220 feet, a length of 1,200 feet north, or to the Inner Beacon, and to widen it to 220 feet for a length of 4,400 feet, where the widths were from 60 to 100 feet. This makes the entrance channel 220 feet wide and 15 feet deep at mean low water from the entrance of the harbor to the Inner Beacon, a distance of 5,600 linear feet.

The above work of the fiscal year was executed under the appropriation of June 3, 1896, of $28,000, of which $10,000 is to be applied to the channel to the Yellow Mill Bridge as soon as a drawbridge shall be built. Plans for this bridge have been approved, but no work has been done; therefore this part of the appropriation is still unexpended, but its expenditure is now authorized by the sundry civil act of July 1, 1898.

Bridgeport, the port of entry for the collection district of Fairfield, is situated about 2 miles from Long Island Sound, at the head of Bridgeport Harbor. There is a light-house at the entrance to the harbor, and a small harbor light at the Inner Beacon.

Fort Schuyler, Throgs Neck, at the head of Long Island Sound, is about 41 miles to the southwest, and is the nearest work of defense.

Money statement.

July 1, 1897, balance unexpended	$26,044.95
June 30, 1898, amount expended during fiscal year	15,691.96
July 1, 1898, balance unexpended	10,352.99
July 1, 1898, outstanding liabilities	100.00
July 1, 1898, balance available	10,252.99
Amount (estimated) required for completion of existing project	87,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

Appropriations for the improvement of Bridgeport Harbor, Connecticut, have been made as follows:

Application.	Date.	Amount.
Dredging outer bar	July 4, 1836	$10,000
Dredging outer and inner bars	Aug. 30, 1852	10,000
Dredging and 521 feet of breakwater	Mar. 3, 1871	20,000
Dredging and 859 feet of breakwater	June 10, 1872	40,000
Dredging inner bar and upper harbor	Mar. 3, 1873	30,000
Dredging bridge to Long Island Sound (9 feet)	June 23, 1874	20,000
Dredging bridge to Long Island Sound (12 feet)	Mar. 3, 1875	15,000
Dredging upper harbor (9 feet)	Aug. 14, 1876	10,000
Dredging above bridge and outer bar (9 and 12 feet)	June 18, 1878	10,000
Dredging bridge to Long Island Sound (12 feet)	Mar. 3, 1879	10,000
Do	June 14, 1880	10,000
Dredging about Inner Beacon (12 feet)	Mar. 3, 1881	10,000
Dredging between Inner Beacon and railway wharf (12 feet)	Aug. 2, 1882	10,000
Do	July 5, 1884	5,000
Do	Aug. 5, 1886	20,000
Dredging above horse-railroad bridge (9 feet)	Aug. 11, 1888	10,000
Dredging and breakwater at Tongue	Sept. 19, 1890	20,000
Dredging between Inner Beacon and Naugatuck Wharf	July 13, 1892	20,000
Dredging outer bar (15 feet)	Aug. 18, 1894	10,000
Dredging between Outer Beacon and Long Island Sound	June 3, 1896	28,000
Total		318,000

Abstract of proposals for dredging in Bridgeport Harbor, Connecticut, opened by Maj. Smith S. Leach, Corps of Engineers, December 17, 1896.

[Estimated yardage, 140,000 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
		Cents.	
1a	George B. Beardsley, Bridgeport, Conn	10	$14,000.00
2	E. R. Seward, Albany, N. Y	17	23,800.00
3	International Construction Co., Syracuse, N. Y	17	23,800.00
4	Alonzo E. Smith, Islip, N. Y	15	21,000.00

a Accepted.

Contract in force for dredging in Bridgeport Harbor, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
George B. Beardsley	Dec. 28, 1896	Feb. 1, 1897	Aug. 3, 1897	a Dec. 31, 1897

a Extended to July, 16, 1898.

COMMERCIAL STATISTICS FOR THE YEAR 1897.

[Through courtesy of F. J. Naramore, collector of customs.]

Foreign.

Value of imports	$243,550
Revenue receipts, duties on imports	74,470
Foreign vessels:	
Entered	6
Cleared	6
Total	12
Domestic vessels:	
Entered	3
Cleared	3
Total	6

Net tonnage of vessels owned at this port.

	Number.	Tons.
Steamers	29	4,865
Sailing vessels	36	4,101
Barges	1	125
Total	66	9,091

The number of vessels (66) given as owned at this port only covers those of over 5 tons measurement; of smaller there are very many more than this, of which I have no list.

COMMERCIAL STATISTICS FOR THE YEAR 1897.

[Through courtesy of Capt. John McNeil, harbor master of Bridgeport.]

Arrival and departure of vessels—Coastwise.

[Draft, 12 to 18 feet; tonnage, 100 to 1,250 tons.

Kind of vessel.	Number of round trips.	Aggregate tonnage of all trips.
Steamers	7,797	1,260,862
Sailing vessels	5,207	
Barges	5,560	
Total	18,564	1,260,862

In addition to the above there are 375 vessels, including small steamers and sailing vessels, engaged in the oyster industry of this port.

Over 300,000 bushels of oysters have been sold from here during the past year, business being carried on by above vessels.

Freight received and shipped by water.

	Tons.	Estimated value.
Receipts	792,095	$26,752,125
Shipments	289,878	28,864,231
Total	1,081,973	55,616,356

The above figures show an increase of 65,755 tons above that reported for 1896.

One hundred and thirty-four vessels during the past year have been rebuilt and repaired, and four new ones have been built here.

New lines of transportation established during the fiscal year, none.

The Bridgeport and Port Jefferson Steamboat Company have increased their carrying facilities by the building of a much larger steamer than the *Monowantic*, now in use.

Our vessels arriving here now have decreased in numbers but increased in tonnage.

D 11.

IMPROVEMENT OF SAUGATUCK RIVER AND WESTPORT HARBOR, CONNECTICUT.

The present project for this work, adopted in 1892 and modified June 3, 1896, consists in dredging a channel 4 feet deep at mean low water and 60 feet wide up to the village of Westport, in removing rocks and bowlders from the channel, and in repairing the breakwater at Cedar Point, at an estimated cost of $18,000.

On July 1, 1897, the channel had been dredged 40 to 60 feet wide and 4 feet deep at mean low water to the lowest wharf at Westport, and vessels of 10 feet draft could reach that point at high tide.

The breakwater had been repaired and extended up the beach 30 feet. Thirty-six tons of rock had been removed from the channel.

At the beginning of the fiscal year, under the appropriation of June 3, 1896, a contract with T. A. Scott, dated March 11, 1897, for removal of bowlders at $7 per ton, had just been commenced, and 36 tons of bowlders had been removed.

Work under this contract was continued to July 7, 1897, upon which date it was completed. Sixty-seven tons of rock were removed during

the fiscal year, making the total amount removed under the contract 103 tons, which sufficed to clear the natural channel from the railroad bridge at Westport, although some bowlders still remain on the borders of the channel.

Saugatuck River is in the Fairfield collection district, of which Bridgeport is the port of entry. The nearest light-house is on Sheffield Island, 5 miles southeast from the river's mouth. Fort Schuyler, Throgs Neck, at the head of Long Island Sound, 32 miles southwest, is the nearest work of defense.

Money statement.

July 1, 1897, balance unexpended	$1,329.30
June 30, 1898, amount expended during fiscal year	780.20
July 1, 1898, balance unexpended	549.10
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

Appropriations for this harbor have been made as follows:

Title.	Application.	Date.	Amount.
Survey of river and harbor of Saugatuck	Survey	May 20, 1826	$400
Removing obstructions in river and protecting harbor at Cedar Point.	Chiefly constructing breakwater at Cedar Point.		
Removing obstructions in river	As stated, location not known	Apr. 30, 1830	28
For further securing the beach at Cedar Point.	Continuing breakwater	July 4, 1836	1,000
Harbor of Westport	Canal construction	do	3,000
Do	do	May 3, 1837	3,734
Do	do	July 7, 1838	4,782
Deepening and improving Westport Harbor, unexpended balance reverted to Treasury in 1870; reappropriated in 1871.	Chiefly in surveys in 1872	Mar. 2, 1867	2,500
Westport Harbor	Repairing and extending breakwater on Cedar Point.	July 11, 1870	2,500
Saugatuck River, improvement of the natural channel.	Dredging	July 13, 1892	7,000
Saugatuck River, for completion	do	Aug. 18, 1894	3,000
Westport Harbor, Connecticut	Removal of rocks and repair of breakwater.	June 3, 1896	3,000
Total			32,444

The appropriations since 1892 have been applied to the present project.

Abstract of proposals for removal of bowlders from Saugatuck River, Connecticut, opened by Maj. Smith S. Leach, Corps of Engineers, February 26, 1897.

[Estimated tonnage, 100 gross tons.]

No.	Name and address of bidder.	Price per gross ton.	Total.
1	John Beattie, Leete Island, Conn	$10.00	$1,000
a2	Thomas A. Scott, New London, Conn	7.00	700
3	D. Toomey, Guilford, Conn	10.00	1,000
4	James S. Rogers, Plattsburg, N. Y	8.90	890

a Accepted.

Contract in force for removal of bowlders from Saugatuck River, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
T. A. Scott	Mar. 11, 1897	Mar. 22, 1897	June 28, 1897	July 1, 1897

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1897.

These have been asked for, but have not been received. The following is the report for 1896:

Arrival and departure of vessels.

WESTPORT HARBOR.

[Draft, 4 to 10½ feet; tonnage, 50 to 300 tons.]

Kinds of vessels.	Round trips.	Aggregate tonnage of all trips.
Sailing vessels	18	2,707
Steamers of all kinds	177	30,800
Barges, scows, etc	150	18,000
Total	345	51,507

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Coal	9,200	$46,000
Lumber (425,000 feet, B. M.)	637	8,500
Miscellaneous	23,670	710,100
Total	33,507	764,600

The above figures show an increase of 4,567 in tonnage of freight over that reported for the year 1895, which was 28,940 tons.

No new lines of transportation established since January 1, 1898.

D 12.

IMPROVEMENT OF NORWALK HARBOR, CONNECTICUT.

The present project for this work, adopted August 17, 1894, and extended June 3, 1896, provides for dredging and removing the shoal called Ferrys Point on the west side of the channel, between the railroad dock and Jenning's wharf, making 6 feet depth at mean low water, in widening two bends at the harbor entrance, making a depth of 10 feet at mean low water, and in dredging to widen to 150 feet and deepen to 10 feet the channel at mean low water up to South Norwalk.

Estimated cost, $77,000, and $2,000 per annum for maintenance.

On July 1, 1897, Ferrys Point had been removed and the bend at Oyster Shell Point reduced. The bends at harbor entrance, Keyser's Island, and Black Buoy Point have been widened, the latter to full dimensions proposed and the former about half completed. The channel below the bridge had been widened 40 feet for a length of 1,600 feet on the east side opposite the docks.

Nothing was done during the past fiscal year.

Under date of November 30, 1897, a report upon the survey of the harbor of South Norwalk, authorized by the river and harbor act of June 3, 1896, was made; and estimates were submitted for deepening the present channel above the railroad bridge to 8 feet at mean low water, at a cost of $13,200, and for making a channel to East Norwalk 6 feet deep and 60 feet wide, at a cost of $5,760, and for annual maintenance at a cost of $2,500 per annum. This proposed addition to the

present project was approved by the Chief of Engineers, and was referred to Congress by the Honorable the Secretary of War under date of December 8, 1897.

Norwalk is in the Fairchild collection district, and is 11 miles west of Bridgeport, the port of entry. Norwalk light-house is on Sheffield Island, at the harbor entrance. The nearest work of defense is Fort Schuyler, Throgs Neck, at the head of Long Island Sound, about 29 miles southwest.

Money statement.

July 1, 1897, balance unexpended	$555.98
June 30, 1898, amount expended during fiscal year	107.15
July 1, 1898, balance unexpended	448.83
Amount (estimated) required for completion of existing project	52,000.00
Amount required for maintenance annually	2,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

Appropriations for improving Norwalk Harbor, Connecticut, have been made as follows:

Application.	Date.	Amount.
For previous projects:		
Dredging (6 feet) above South Norwalk	June 10, 1872	$10,000
Do	Mar. 3, 1873	10,000
Do	June 23, 1874	10,000
Dredging (6 feet) below South Norwalk	Mar. 3, 1875	7,000
Do	June 18, 1878	6,000
Dredging (6 feet) above and below South Norwalk	Mar. 3, 1879	10,000
Dredging (6 feet) below South Norwalk	June 14, 1880	5,000
Dredging (8 feet) below and (6 feet) above South Norwalk	Mar. 3, 1881	5,000
Dredging (6 feet) above South Norwalk	Aug. 2, 1882	5,000
Dredging (8 feet) below South Norwalk	July 5, 1884	5,000
Dredging (6 feet) above South Norwalk	Aug. 5, 1886	3,000
Dredging (6 feet) above and (8 feet) below South Norwalk	Aug. 11, 1888	3,000
Do	Sept. 19, 1890	4,000
Total		83,000
For present project adopted 1894:		
Dredging (6 feet) at Ferrys Point	Aug. 18, 1894	15,000
Dredging (10 feet) below South Norwalk	June 3, 1896	10,000
Total for present project		25,000
Total appropriated for improvement of Norwalk Harbor, Connecticut		108,000

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1897.

These have been asked for, but have not been received. The following is the report for 1896:

Arrivals and departures of vessels.

[Draft, 4 to 14 feet; tonnage, 50 to 600 tons.]

Kinds of vessels.	Round trips.
Steamers of all kinds	605
Sailing vessels	121
Barges	257
Total	983

The above does not include the frequent trips made by 43 oyster steamers (total tonnage, 2,505 gross tons) and numerous small sailboats employed in the oyster industry.

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Coal	73,780	$219,585
Building materials	24,755	168,514
Miscellaneous materials	43,500	4,614,250
Oysters and shellfish	4,000	130,000
Total	146,045	5,134,349

The above figures show a decrease of 55,050 tons from the report for the calendar year 1895, when 201,095 tons were reported, but the estimated value of the freight is $212,762 greater for 1896 than for 1895.

No new lines of transportation have been established during the year.

D 13.

IMPROVEMENT OF FIVE-MILE RIVER HARBOR, CONNECTICUT.

The adopted project for this harbor consists in dredging a channel 8 feet deep at mean low water, and 100 feet wide, from Long Island Sound to the head of the harbor, a distance of about 6,000 feet, at an estimated cost of $45,000.

At the beginning of the fiscal year a contract was in force with George B. Beardsley, dated December 28, 1896, for removing about 20,000 cubic yards of material, at 8½ cents per yard.

Work under this contract was commenced on October 23, 1897, and completed on December 1, 1897, 21,956 cubic yards of material having been dredged. Four thousand four hundred and fifty-three cubic yards of the material removed were harder material than contracted for and payment was made under "oral agreement" at a rate of 14.3 cents per yard. The work done under the contract was to widen the dredged channel about 40 feet, making it 100 feet wide between the Sound entrance and the lower docks, a distance of 2,250 feet, and to remove a small shoal which had formed across the entire width of the channel near its mouth. All dredging was carried to a depth of 8 feet at mean low water.

Five-mile River is in the Fairfield collection district and is about 13 miles west of Bridgeport, the port of entry. The nearest light-house is on Sheffield Island, nearly 2 miles from the mouth of the harbor. The nearest work of defense is Fort Schuyler, at the head of Long Island Sound, 27 miles southwest.

Money statement.

July 1, 1897, balance unexpended	$2,692.16
June 30, 1898, amount expended during fiscal year	2,416.56
July 1, 1898, balance unexpended	275.60
Amount (estimated) required for completion of existing project	25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

Appropriations for improving harbor at Five-mile River, Connecticut, have been made as follows:

Application.	Date.	Amount.
Dredging	Aug. 11, 1888	$5,000
Do	Sept. 19, 1890	5,000
Do	July 13, 1892	5,000
Do	Aug. 18, 1894	2,000
Do	June 3, 1896	2,500
Total		19,500

Abstract of proposals for dredging in Five-mile River Harbor, Connecticut, opened by Capt. Smith S. Leach, Corps of Engineers, December 17, 1896.

[Estimated yardage, 20,000 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
		Cents.	
1	George B. Beardsley, Bridgeport, Conn	8½	a $1,700
2	Edgar M. Payn, Albany, N. Y	20½	4,175
3	Newburg Dredging Co., Newburg, N. Y	12	2,400
4	Alonzo E. Smith, Islip, N. Y	24	4,800
5	William H. Taylor, jr., Jersey City, N. J	12¾	2,550
6	John P. Randerson, Albany, N. Y	14	2,800

a Accepted.

Contract in force for dredging in Five-mile River Harbor, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
George B. Beardsley	Dec. 28, 1896	Feb. 1, 1897	Oct. 28, 1897	Dec. 31, 1897

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1897.

Arrivals and departures of vessels.

FIVE-MILE RIVER HARBOR.

[Draft, 3 to 8 feet; tonnage, 40 to 104 gross tons.]

Kind of vessels.	Number of round trips.
Steamers (including oyster steamers)	1,000
Sailing vessels	a 7,500
Barges	6
Total	8,506

a Includes the numerous trips made by about 40 small oyster boats.

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Receipts:		
Coal	1,500	$6,000
Oysters	7,180	149,167
Miscellaneous (not otherwise included)	300	1,500
Total receipts	8,980	156,667
Shipments:		
Oysters, produce, etc., of which 2,000 tons were oysters for shipment to Europe	2,000	54,167
Other transactions in oysters and clams, sales to dealers, planters, and consumers, about	5,180	95,000
Oyster shells	1,000	3,080
Total shipments	8,180	152,247

The above figures show an increase of 5,862 tons over the last report received, that of 1895.

No new lines of transportation established since January 1, 1897.

All of the above figures are estimates based upon the best information obtainable.

D 14.

IMPROVEMENT OF STAMFORD HARBOR, CONNECTICUT.

The approved project for this harbor consists in dredging to make channels in the East and West branches. That in the West Branch is to be about 1½ miles long, 150 feet wide, and 7 feet deep at mean low water, with a basin between harbor lines at its head, and the one in the East Branch to be 100 feet wide and 9 feet deep at mean low water for a length of 8,535 feet, and thence to the head of the harbor about 1,200 feet with same depth and width of 50 feet; all at a total estimated cost of $123,500.

Up to July 1, 1897, the channel in the East Branch had been excavated full length and depth, but with reduced width. That in the West Branch had been dug to full depth and reduced width for about half its length.

At the beginning of the fiscal year a contract with Mr. Frank H. Brainard, dated December 28, 1896, for the removal of about 80,000 cubic yards of material from the West Branch, at 9½ cents per yard, had just been commenced, the amount of material removed to that date having been 7,034 cubic yards.

Work on this contract was completed on August 30, 1897, 72,133 cubic yards of material having been dredged during the fiscal year, making the total amount under the contract 79,167 cubic yards, most of the material being sand, mud, and gravel. Two thousand five hundred and eighty-five cubic yards of the material removed were hardpan, for the removal of which, under "oral agreement," 25 cents per cubic yard was paid. The contractor was also paid $51 for six hours' work upon the removal of two large bowlders from the channel. The work done under the contract was to extend the proposed channel for full width of 150 feet from Cooks Point to the middle docks, a distance of about half a mile; also, to widen the channel below Cooks Point about 40 feet, making it the full project width of about 150 feet. This completes the improvement of the West Branch from the entrance to the middle docks, a distance of about a mile. The basin at the head still remains to be dredged.

No work was done in the East Branch during the fiscal year.

Stamford Harbor is in the Fairfield collection district, of which Bridgeport is the port of entry. There is a light-house on the middle-ground at the harbor entrance. The nearest work of defense is Fort Schuyler, Throgs Neck, 20 miles to the southwest.

Money statement.

July 1, 1897, balance unexpended	$9,276.95
June 30, 1898, amount expended during fiscal year	8,570.48
July 1, 1898, balance unexpended	706.47
Amount (estimated) required for completion of existing project	88,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

Appropriations for improving Stamford Harbor, Connecticut, have been made as follows:

Application.	Date.	Amount.
For previous projects:		
Dredging West Branch 5 feet deep	Aug. 5, 1886	$10,000
Do	Aug. 11, 1888	5,000
Do	Sept. 19, 1890	5,000
Total		20,000
For the present project:		
Dredging and rock removal, East Branch, $13,800; dredging West Branch, $1,200	July 13, 1892	15,000
Dredging and rock removal, East Branch, $5,000; dredging West Branch, $5,000	Aug. 18, 1894	10,000
Dredging West Branch	June 3, 1896	10,000
Total		35,000

Abstract of proposals for dredging in Stamford Harbor, Connecticut, opened by Capt. Smith S. Leach, Corps of Engineers, December 17, 1896.

[Estimated yardage, 80,000 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
		Cents.	
1	Edgar M. Payn, Albany, N. Y	20.9	$16,720
2	Newburgh Dredging Co., Newburgh, N. Y	13	11,100
3	E. R. Seward, Albany, N. Y	14	11,600
a4	Frank H. Brainard, New York, N. Y	9	7,600
5	Alonzo E. Smith, Islip, N. Y	16	12,800
6	Hartford Dredging Co., Hartford, Conn	10.4	8,320
7	Wm. H. Taylor, jr., Jersey City, N. J	14	11,200
8	John P. Randerson, Albany, N. Y	12½	9,800

a Accepted.

Contract in force for dredging in Stamford Harbor, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
Frank H. Brainard	Dec. 23, 1896	Jan. 15, 1897	June 23, 1897	Dec. 31, 1897

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1897.

These have been asked for, but have not been received. The following is the report for 1896:

[Through the courtesy of Mr. E. B. Goddard, deputy collector of customs.]

Arrival and departure of vessels.

[Draft, 5 to 15 feet; tonnage, 20 to 550 tons.]

Kind of vessels.	Round trips.
Steamers	1,166
Sailing vessels	407
Barges	637
Total	2,210

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Coal	84,258	$381,005
Building materials	49,500	460,000
Miscellaneous	240,000	10,475,642
Total	373,758	11,316,647

The above figures show an increase of 153,252 tons of freight above that reported for 1895, which was 220,506 tons.

Lines of transportation established since January 1, 1896: The steam-screw vessel *Defender* has been running to Northport, L. I., since May 1, 1897, and is known as the Stamford and Northport Ferry Line.

This report includes all the harbor of Stamford, east and west sides.

D 15.

IMPROVEMENT OF HARBOR AT COSCOB AND MIANUS RIVER, CONNECTICUT.

The approved project for the harbor consists in dredging a channel 1½ miles in length, 6 feet deep at mean low water, 150 feet wide, from the 6-foot curve in the harbor to the bridge, two-fifths mile, and thence 100 feet wide to the head, four-fifths mile, together with a turning basin near the lower end 300 by 1,750 feet, at an estimated cost of $54,000.

On July 1, 1897, the upper half mile of the channel and the basin remained to be done.

At the beginning of the fiscal year work had just been commenced under a contract with William H. Taylor, jr., dated December 30, 1896, for dredging about 60,000 cubic yards of material from the basin, at 9 cents per yard.

Work under the contract commenced on June 30, 1897, and 1,876 cubic yards of mud were removed on that day. The work was continued from that date and completed on August 5, 1897, the amount of mud removed during the fiscal year being 58,124 cubic yards, making the total amount of mud dredged under the contract 60,000 cubic yards. The work was all applied to the turning basin, completing nearly the east half of the area designed to be dredged.

Coscob Harbor and Mianus River are in the collection district of Fairfield, Conn., of which Bridgeport is the port of entry. The nearest light-house is on Great Captains Island, about 2 miles southwest from the harbor entrance. Fort Schuyler, Throgs Neck, New York, 18 miles to the southwest, is the nearest work of defense.

Money statement.

July 1, 1897, balance unexpended	$7,557.59
June 30, 1898, amount expended during fiscal year	6,007.43
July 1, 1898, balance unexpended	1,550.16
Amount (estimated) required for completion of existing project	35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

Appropriations for improving Coscob Harbor and Mianus River have been made as follows:

Application.	Date.	Amount.
Dredging below railway bridge	July 12, 1892	$7,000
Dredging above railway bridge	Aug. 18, 1894	4,000
Dredging turning basin	June 3, 1896	8,000
Total		19,000

Abstract of proposals for dredging in Coscob Harbor and Mianus River, Connecticut, opened by Capt. Smith S. Leach, Corps of Engineers, December 17, 1896.

[Estimated yardage, 60,000 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
		Cents.	
1	Edgar M. Payn, Albany, N. Y	21½	$13,125
2	Newburgh Dredging Co., Newburg, N. Y	15	9,000
3	Alonso E. Smith, Islip, N. Y	14	8,400
4	Hartford Dredging Co., Hartford, Conn	9 3/10	5,580
a5	Wm. H. Taylor, jr., Jersey City, N. J	9	5,400
6	John P. Randerson, Albany, N. Y	11¾	7,050
7	James McSpirit, Jersey City, N. J	12 9/10	8,280

a Accepted.

Contract in force for dredging in Coscob Harbor and Mianus River, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
Wm. H. Taylor, jr	Dec. 30, 1896	Jan. 15, 1897	June 30, 1897	Dec. 31, 1897

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1897.

[Through the courtesy of Mr. Chas. E. Diefenthaler, Commodore, Riverside Yacht Club.]

Arrivals and departures of vessels.

[Draft, 4 to 8 feet; tonnage, 25 to 100 tons.]

Kind of vessel.	Number of vessels.	Number of round trips.	Aggregate tonnage of all trips.
Steamers	8	120	8,200
Sailing vessels	70	280	56,000
Barges	4	24	2,400
	82	424	61,600

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Receipts: Coal, timber, oysters, ship-building materials, hardware, and general merchandise	18,100	$77,500.00
Shipments: Ice, car sweepers, oysters, fish, and farm products	43,400	265,000.00
Total	61,500	342,500.00

The above figures show an increase in tonnage of 9,900 tons over the report for 1894, which was the last received.

The Riverside Yacht Club has 83 yachts in its fleet, most of which anchor in the harbor.

No lines of transportation established since January 1, 1896.

D 16.

IMPROVEMENT OF GREENWICH HARBOR, CONNECTICUT.

The approved project for this harbor is to dredge a channel 90 feet wide from the mouth of the harbor to a causeway at its head, to be 9 feet deep at mean low water to the lower docks, a distance of half a mile, and 6 feet deep above, a distance of half a mile; the upper end is to be slightly enlarged to form a turning basin; all at an estimated cost of $20,000.

Under the first appropriation for this work, that of June 3, 1896, a contract was made with the Hartford Dredging Company, dated December 30, 1896, for the removal of about 35,000 cubic yards of material at 10.7 cents per yard. Work under this contract was commenced on October 25, 1897, and finished on January 15, 1898. Thirty-five thousand cubic yards of mud, with occasionally a slight admixture of sand, were removed under the contract during the fiscal year. The work done was to make a channel, 6 feet deep at mean low water and 45 feet wide, from the 6-foot curve opposite the lower dock nearly to the causeway at the head of the harbor, a distance of about half a mile.

Greenwich Harbor is in the collection district of Fairfield, Conn., of which Bridgeport is the port of entry. The nearest light-house is on Great Captains Island, about 2 miles southward. The nearest work of defense is Fort Schuyler, Throgs Neck, New York, about 16 miles to the southwest.

Money statement.

July 1, 1897, balance unexpended	$5,389.09
June 30, 1898, amount expended during fiscal year	4,449.35
July 1, 1898, balance unexpended	939.74
July 1, 1898, outstanding liabilities	125.00
July 1, 1898, balance available	814.74
Amount (estimated) required for completion of existing project	14,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	14,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

The only appropriation for improving Greenwich Harbor, Connecticut, is the one of $6,000 made by the river and harbor act of June 3, 1896.

Abstract of proposals for dredging in Greenwich Harbor, Connecticut, opened by Capt. Smith S. Leach, Corps of Engineers, December 17, 1896.

[Estimated yardage, 35,000 cubic yards.]

No.	Name and address of bidder.	Price per cubic yard.	Total.
		Cents.	
1	Edgar M. Payn, Albany, N. Y	20½	$7,087.50
2	Newburgh Dredging Co., Newburg, N. Y	12	4,200.00
3	Alonzo R. Smith, Islip, N. Y	18	6,300.00
4	Hartford Dredging Co., Hartford, Conn	10.7	a 3,745.00
5	Wm. H. Taylor, jr., Jersey City, N. J	12	4,200.00
6	John P. Randerson, Albany, N. Y	17¾	6,212.50
7	James McSpirit, Jersey City, N. J	15¼	5,530.00

a Accepted.

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PROPOSED CHANNEL
ROUND ISLAND
HARBOR LINE
STEAMBOAT ROAD
GREENWICH AVE
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LINE
ter to mean low water.
ge of tides 7.5 feet.
are shown thus:—
water line
foot curve
line shown thus:

Contract in force for dredging in Greenwich Harbor, Connecticut.

Name of contractor.	Date of contract.	Date of approval.	Work begun.	Contract expires.
Hartford Dredging Co	Dec. 30, 1896	Feb. 10, 1897	Oct. 25, 1897	a Dec. 31, 1897

a Extended to April 30, 1898.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1897.

Arrivals and departures of vessels.

[Draft, 3 to 14 feet; tonnage, 40 to 750 tons.]

Kind of vessels.	Number of round trips.
Steamer Maid of Kent, passenger and freight line	Daily trips.
Sailing vessels, schooners, brigs, and sloops	Do.
Steam barges, steam canal boats, and steam lighters	Weekly trips.
Coal barges (in tow of tugs)	Two and three each week.

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Coal	25,000	$125,000
Lumber, 15,000,000 feet	15,000	2,500,000
Brick, 12,000,000	24,000	75,000
Gravel, 30,000 cubic yards; Trap rock, 30,000 cubic yards; Crushed stone, 30,000 cubic yards	35,000	45,000
Lime, 60,000 barrels; Cement, 60,000 barrels; Plaster, 60,000 barrels	9,000	75,000
Wall plaster and mortar in bags	2,500	15,000
Grain, 500,000 bags	2,500	450,000
Quarried stone, 7,500 cubic yards	13,000	22,500
Miscellaneous, tile pipe, iron pipe, bluestone flagging, etc	5,000	125,000
General freight by propeller Maid of Kent (150 tons each trip)	45,000	2,000,000
	198,500	5,432,500

The above figures show an increase of 88,500 tons over the report for 1894, which was the only one received heretofore.

LETTER OF MR. C. H. HOLMES AND OTHERS.

GREENWICH, CONN., ——, ——.

SIR: In compliance with your request for statistics for Greenwich, Conn., for the calendar year 1897, we beg to submit the inclosed statement. We can also say that we have derived some benefit already from the work done, although the work is not yet complete.

There is contemplated a new transportation boat to New York just as soon as sufficient water is given so a suitable vessel can make trips on time without regard to tides. This vessel will carry both passengers and freight, and will certainly increase the business 50 per cent.

Contracts are now about closed for new docks and bulkheads along the line of the channel now being dredged (one wall being already started.

The extra depth of water that we will have will enable us to secure much lower freight rates and freight in larger vessels, thus saving at least 10 per cent in our freights. We beg to remain,

Very respectfully, yours,

C. H. HOLMES,
Greenwich Passenger and Freight Line.
BANKS & BRUSH.
JAMES MAHER.
W. J. SMITH.

Maj. SMITH S. LEACH,
Corps of Engineers, U. S. A.

D 17.

SURVEY OF CONNECTICUT RIVER BETWEEN HARTFORD, CONNECTICUT, AND HOLYOKE, MASSACHUSETTS.

[Printed in House Doc. No. 136, Fifty-fifth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 6, 1897.

SIR: I have the honor to submit the accompanying copy of report, dated November 13, 1897, with maps* and profile,[1] by Maj. Smith S. Leach, Corps of Engineers, upon a survey of Connecticut River between Holyoke, Mass., and the foot of the Enfield Rapids, made to comply with the provisions of the river and harbor act of June 3, 1896.

It was found necessary to include in the study for improvement that portion of the river between the foot of Enfield Rapids and Hartford, and the plan presented provides for securing between Holyoke and Hartford a channel 9 feet deep at extreme low water and 150 feet wide at the same stage, by the construction of three locks and movable dams, including the excavation of material where required. The cost of the work, including that for flowage, is estimated at $1,825,000, but this total would be increased to $2,075,000 should the Chanoine type of dams be used, while the cost of maintenance, together with operation of the locks and dams, the necessary repairs to the same, and the small amount of dredging possibly required to keep open the artificial cuts, is estimated approximately at $8,000 per annum.

The execution of the plans submitted would result in no injury to the canal on the west bank or to water power. Reference is made to the fact that there are eleven bridges spanning the river between Hartford and Chicopee, which would not permit traffic under the proposed project. One of these structures, a temporary highway bridge at Hartford, will be replaced by a permanent one, the approved plan for which provides ample draw opening.

Major Leach states that a military reason of some weight for making the proposed improvement is the provision of water carriage to the United States Arsenal at Springfield, and it is his opinion, in view of the estimated cost of the project and the commercial importance of the river, that it is worthy of improvement between Hartford and Holyoke by the General Government in the manner and to the extent set forth, and this opinion is concurred in by the Division Engineer, Col. G. L. Gillespie, Corps of Engineers.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers, U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF MAJ. SMITH S. LEACH, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
New London, Conn., November 13, 1897.

GENERAL: I have the honor to submit the following report upon a "survey of the Connecticut River between Holyoke and the foot of

*Not reprinted. Printed in House Doc. No. 136, Fifty-fifth Congress, second session.

Enfield Rapids," made pursuant to the requirements of the river and harbor act of June 3, 1896. Under date of July 13, 1896, the Chief of Engineers assigned this survey to Maj. H. M. Adams, and directed that the expenditures—not to exceed $2,000—be paid from the unexpended balance of the appropriation of 1880 for "improving the Connecticut River between Hartford and Holyoke." In August, 1896, the work was transferred to me by order of the Chief of Engineers.

The part of the Connecticut River between Hartford and Holyoke has been the subject of very elaborate surveys and of an exhaustive study based thereon, having in view the development of a plan of improvement. The surveys alluded to were made in 1871–1874, were under the direction of Gen. G. K. Warren, Corps of Engineers, and were conducted by Gen. Theodore G. Ellis, civil engineer. The results of the surveys and of the studies based thereon are published in full in the report of the Chief of Engineers, 1878, pages 248–391, and in House Ex. Doc. No. 101, Forty-fifth Congress, second session. The character of the survey and the detail with which the results are recorded made it unnecessrry to do more in the way of field work than to ascertain whether the conditions remain the same, and, if not, to determine what the changes have been. The part of the river designated in the act consists of two stretches of somewhat diverse characteristics. From Holyoke to Enfield Dam, a distance of 18 miles, the stream has in the main an erosible bed, while from the dam to the foot of the rapids, the lower limit of the authorized survey, the bed is in rock or other material practically nonerosible. As changes could be the result of erosion only, the search for them was limited to the upper stretch. This was sounded, and shore lines rerun between October 6 and 21, 1896, by a party in charge of Assistant Engineer H. B. Gorham. The results are shown on three sheets of the maps herewith, Nos. 4, 5, and 6 of the serial notation. For the rapids the results of the Ellis survey have been wholly relied upon. The fullest use has been made of General Ellis's results, and much physical data of value have been drawn from the report of testimony taken by the examiner in the case of Holyoke Water Power Company *v.* Connecticut River Company, in which the effect of a constrained flow is fully canvassed by Mr. Clemens Herschell and other experts.

Though not included in the authorized survey, it was found necessary to include in the study for improvement the portion of the river between the foot of Enfield Rapids and Hartford. This portion is obstructed by shifting sand bars, and has doubtless changed since the previous survey. Such changes as have occurred will not, however, have any particular bearing upon the feasibility or cost of improvement. Hence the results of the old survey have been assumed to represent present conditions, and are shown on plates 1, 2, and 3 herewith.

The portion of the Connecticut River between Holyoke, Mass., and Hartford, Conn., is 34 miles in length. At Holyoke navigation is interrupted by a dam for the development of power, which has no provision for passing vessels. As already intimated, this portion of the river is divided into three stretches by the different physical characteristics of its bed. The first stretch, extending from Holyoke to Enfield Dam, 18 miles, presents a trace of moderate and regular curvature. The width between the bank lines varies from 650 to 2,100 feet, but the prevailing width is between extremes of 800 and 1,200 feet. The unusual figure of 2,100 feet is to be found only at Longmeadow, 15 miles from Holyoke, where, for more than a mile, the width is quite uniform and more than double the normal. The bed and channel of the stream are coincident

at all usual stages, including freshets of frequent recurrence. At an extreme freshet there is a scanty alluvial plain subject to overflow, limited, generally speaking, to Longmeadow and the lower valleys of the Chicopee and Agawam rivers, the only important tributaries. The limits of actual overflow are recorded, but it is not possible to distinguish between the effect of backwater from the Connecticut and the flood plain of the tributary.

Except at the upper and lower ends of this stretch, where the bed is rock, the bottom is composed of sand and gravel, with some admixture of mud below Springfield. The disposition of the erosible material is in bars or shoals with intervening pools, but the bars are relatively stable in position and form and appear to represent a substantial equilibrium of the forces developed by variation of width, curvature, and volume.

The natural regimen of this part of the stream is a matter of conjecture only. All available data of depth and velocity have been taken since the construction of Enfield Dam. An inspection of the profile on pl. 7 herewith, based on Pl. V of General Ellis's report, indicates that before the construction of Enfield Dam the head of the rapids was at Longmeadow Bar, 3 miles above, which formed a natural dam with but 3 or four feet lower crest. Under the present artificial conditions the prevailing channel depth is 9 feet or more, except at two points, Longmeadow and mouth of Chicopee River, where there are 4 and 3 feet at low water, respectively. The discharge varies from 4,000 to 200,000 cubic feet per second, giving an oscillation from extreme low to extreme high water of 28 feet at the foot of Holyoke Falls and 16 feet immediately above Enfield dam. The maximum depth of flow over the crest of the dam is about 12 feet.

The second or middle stretch of river as above classified extends from Enfield Dam 5½ miles, and is known as the Enfield Rapids, a name which gives a fair idea of its character. The bed is of rock, rough and irregular, the slope is steep and variable, the banks bluff and mainly of rock. The total fall depends upon the stage of water; but its maximum at extreme low stage probably does not exceed 33 feet, though it has not been actually measured. This portion of river is approximately straight in trace, and except at one point near the middle, where the channel divides into two branches with a considerable island between, the banks are regular and parallel. The conditions of discharge are the same as noted for the first section, except that at low water an appreciable proportion of the entire flow is diverted through a lateral canal on the west bank. At low water open navigation over this section is impossible by reason of deficient depth. At higher stages the depth is sufficient, and the velocity is not so great as to prevent navigation, although it would make it impracticable for any craft not propelled by power. The maximum mean velocity at extreme flood does not exceed 7 miles per hour.

The canal above referred to is the property of a corporation known as the Connecticut River Company. A description of the canal in 1872 and its history up to that time are to be found in the Report of the Chief of Engineers for 1878, Part I, pages 274–275. The rights and responsibilities of the Connecticut River Company appear to be determined by the following extracts from its original charter, given in the Report of the Chief of Engineers above cited:

That the said corporation, for the purpose of widening the channel of said river and deepening the same, shall have power to dig, cleanse, and scour obstructions

from the channels and banks of said river from and above the bridge at Hartford to Springfield, and to erect and build wharves and piers and hedges in said river or on the banks thereof; and the said corporation are empowered to lock the falls at Enfield, on said river, and to make channels to aid them, and to construct a canal on either bank of said river near said falls, and to construct a dam or dams, for the purpose of entering or leaving the locks in still water: *Provided,* The extension and form thereof shall be such as shall not prevent the convenient passage of boats and lumber down the river, nor obstruct the passage of fish.

Three sworn commissioners were provided for in the act, "under whose direction the necessary canal shall be laid out, and who shall inspect the construction of the locks and dams in said river, and cause them to be so constructed that they shall not impede the progress of fish up the river, or the passage of floating boats, timber, or any other property down the river." The commissioners were empowered to suspend the taking of tolls whenever they found the locks out of repair or improperly tended. No penalty other than forfeiture of the right to take tolls appears to attach to the failure of the company to maintain navigation through its canal or elsewhere. It is permitted, but not required, to improve navigation; but it is required to so construct its works as to permit navigation down the river and the passage of fish upstream.

At the present time, as indicated by a casual inspection made during a trip through the canal, the entire work is in a fairly serviceable condition, with the exception of the lowest lock, which needs rebuilding of the side walls. It may be said generally that the Connecticut River Company's canal is navigable to the extent of its dimensions. Such boating as these dimensions permit is not navigation in the present significance of the word, and no feasible alterations of the company's canal will make it so.

To meet its charter requirements of a navigable pass and fishway in its dam, the Connecticut River Company left an opening 150 feet wide in the middle of the dam when first built. At the date of General Ellis's survey that gap had been partly filled by periodic deposits of stone until its crest was but 1½ feet lower than the adjacent parts of the dam. Since that time additional deposits appear to have been made in the gap, though a slight depression remains. As a net result of all work done on the dam since 1854, the extreme low water at Springfield appears to have been raised some 2 feet. No provision has been made for the passage of boats or fish in consequence of the closure of the gap.

The third stretch of river extends from the foot of Enfield Rapids to Hartford, a distance of 10 miles. This portion is of moderate slope, with slight but regular curvature, and a fairly uniform width of 1,500 feet. The bed and banks are of sand and gravel. The banks are generally overflowed at ordinary flood stages. The alluvial plain is one-third of a mile to a mile in width, and the channel of the river lies nearly in the middle of it. The characteristic of this part of the river is the shifting nature of the sand bars or shoals which obstruct it. They extend obliquely across the river, giving a maximum length and minimum depth of overfall in passing from one pool to the next below.

In this stretch of river there were at the date of the old survey five bars giving depth at low water of from 2 to 3 feet. The low-water slope of this reach is 6 inches to the mile; the high-water slope is recorded as slightly less, though as such relation is abnormal for this situation, it is probable that there is some uncertainty about the highest

water marks at the upper end. The high water at Hartford is well determined. The range of discharge is a little greater than on the upper stretch, the low and high water volumes being increased by tributary contributions of small amount, while the volume diverted at Enfield Dam is returned at Windsor Locks.

In addition to the local characteristics of these three sections, there are certain features of regimen common to them all. The river is subject to frequent fluctuations of volume and height. The more considerable freshets are, as a rule, of short duration, and occur in the winter and early spring or in the late fall. The following table, compiled from data published in the Warren-Ellis report, gives the number of days in a year on which the river at Hartford was above certain heights. It is the average of a record kept from 1871 to 1877:

Table showing duration of certain stages of the Connecticut River above Hartford, for seven years, 1871–1877.

Height above Hartford.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	Total days.	Average for seven years.
	Dys.	*Dys.*	*Dys.*	*Dys.*	*Dys.*	*Dys.*	*Dys.*		*Days.*
1 foot	365	366	363	357	365	357	365	2,538	361.71
2 feet	295	359	319	315	331	280	329	2,228	318.29
3 feet	214	311	260	280	261	204	213	1,743	249.00
4 feet	165	258	240	247	198	180	168	1,456	208.00
5 feet	129	203	208	217	138	156	122	1,168	166.86
6 feet	106	145	159	180	107	141	96	934	133.43
7 feet	87	94	117	152	83	126	72	731	104.43
8 feet	63	68	93	136	66	105	64	595	85.00
9 feet	48	54	81	113	51	92	50	489	69.86
10 feet	43	46	67	83	46	74	32	391	55.86
11 feet	39	42	59	62	39	60	24	325	46.43
12 feet	32	32	55	42	33	48	17	259	37.00
13 feet	21	22	49	31	24	41	10	198	28.29
14 feet	11	14	37	22	15	31	7	137	19.57
15 feet	6	10	31	10	11	22	5	95	13.57
16 feet	6	6	18	6	7	16	5	64	9.14
17 feet	4	6	13	5	5	13	5	51	7.29
18 feet	3	5	5	3	3	9	4	32	4.57
19 feet	.....	2	4	3	.....	5	3	17	2.43
20 feet	.....	.....	2	3	.....	3	3	11	1.57
21 feet	.....	.....	.....	2	.....	2	2	6	.86
22 feet	.....	.....	.....	2	.....	.....	2	4	.57
23 feet	.....	.....	.....	2	.....	.....	.....	2	.29

The average gauge profile for the same years is shown on the profile sheet accompanying this report (pl. 7). The river is closed by ice from about December 1 to March 1. The freshet of greatest volume and most certain occurrence, on the whole, is caused by the melting of snows in the spring, and accompanies or immediately follows the disappearance of the ice. For the season of possible navigation it may be stated that freshets frequently recurring are of a magnitude to benefit navigation rather than to impede it. Except ice, floating obstructions are rare, though large quantities of timber have occasionally broken out of booms above Holyoke and gone over the dam and down the river. At no time does the river carry a large enough proportion of suspended sediment to make that a factor in the regimen. The permanency of dredged cuts should not be less than at and below Hartford, but rather more, owing to greater flood velocities and more permanent thalweg.

There are at present thirteen bridges over the river between Hartford and Holyoke, as shown in the following list:

Bridges over Connecticut River, Hartford to Holyoke.

No.		Approximate height above lowest water.	Height above pool. levels.
		Feet.	*Feet.*
1	Highway bridge, at Hartford (with draw openings 118 feet), approved December 28, 1894	.....	.....
2	Railroad bridge, at Hartford (with draw)	.....	.....
3	Suspension bridge, at Windsor Locks (on site of old swing ferry):		
	In center	34	34
	At end piers	24	.....
4	Railroad bridge, iron, just below Kings Island	28	17.5
5	Enfield Bridge (covered wooden truss, in a dilapidated state)	29	18.8
6	Thompsonville, iron highway	24	23
7	South End Bridge, at Springfield, iron	25	24
8	Highway bridge, at Springfield (covered wooden truss)	23	22
9	Railroad bridge, at Springfield, iron	32	31
10	North End Bridge, at Springfield, iron	25	24
11	Chicopee Bridge, highway, wooden truss	28	27
12	Willimansett Bridge, highway, iron	33	32
13	Willimansett Bridge, R. R., iron	35	34

The highway bridge at Hartford (No. 1) is a temporary structure, and a plan for a permanent one to replace it was approved by the Secretary of War under date of December 28, 1894. This approved plan provides for a draw of 118 feet clear opening, which is ample. The last two on the list (Nos. 12 and 13) need not be considered, as they are above the Holyoke terminus of the proposed channel. The remaining ten bridges (Nos. 2 and 11, both inclusive) have no draws which would permit traffic under the proposed project. As will be noted by inspection of the list, their clear heights range from 23 to 35 feet above low water, or 17½ to 34 feet above the corresponding pool levels.

The commercial importance of the Connecticut River in this part of its course must be arrived at by deduction from the statistics of commercial activity in the tributary district. Navigation is not now, and has not been for some years, on a competitive basis, and hence no commerce has sought this route. Only the cities and towns of some importance in the tributary district can be considered, because it is only for such that statistics are available. The benefits derived by the rural community from cheapened transportation and the volume of traffic which it would contribute to a water route are doubtless considerable, but undetermined and indeterminate.

Under a recent act of the legislature of Massachusetts the board of harbor and land commissioners of that State have had under consideration the subject of opening the Connecticut River to Holyoke, and have devoted much attention to obtaining statistics of its commercial importance. The figures used here are from papers prepared for the board and presented at a public hearing held in the city of Springfield on October 29, 1897. Some of the quantities are from official sources, the census of the United States of 1890, and a census taken by the State of Massachusetts in 1895; the remainder are special returns for the year ending October 1, 1897, made out for presentation to the board. All figures of the latter class which are here used have been tested by statistical averages of recognized authority, and have been found substantially accurate.

The section of country which would be benefited by a water terminus at Springfield, with the rail feeders and distributers which such a terminus will naturally command, is estimated to contain 350,000 inhabitants and property to the value of $249,000,000. The four cities of Holyoke, Chicopee, Springfield, and West Springfield are shown by the State census of 1895 to have an aggregate population of 116,000,

and to contain property valued at $106,000,000. From the same source is ascertained that the manufactories of the same four cities in 1895 consumed materials valued at $24,500,000 and made $47,500,000 worth of product. The tonnage of the raw materials and manufactured articles is not reported. From a comparison of the ratio of value and tonnage of similar commerce at other points, the business of these manufactories may be conservatively estimated at 500,000 tons per annum.

The most important single commodity from the freightpayer's standpoint is coal, and for this the figures are quite complete. From reports made by brokers, dealers, and large consumers, who buy direct from mines, it is stated that the annual coal consumption of the four cities is 447,000 tons. This does not include the coal consumed by the railroads, which is probably as much more.

The aggregate freight tonnage of the four cities, as reported by the railroad agents, is 1,800,000 tons per annum. This does not include the coal, iron, or any other supplies for the railways themselves. Such an estimate is, in the nature of things, incomplete, and more apt to err in defect than in excess. The aggregate tonnage of the four cities may be taken at 2,000,000 tons per annum. Of this the coal and manufactories, as above noted, supply 1,400,000 tons, and the remainder, 600,000 tons, is none too large to include the food products, building materials, and supplies of every kind for an urban population of 116,000 souls. Attention is again invited to the fact that all these figures relate to four places only, having an aggregate population of but one-third of the district supposed to be benefited by water carriage to Springfield.

The proportion of this traffic which would avail itself of water carriage is a matter of conjecture. It is within limits to say that 25 per cent, or 500,000 tons, will actually go by water. But a more important fact is not conjectural, and that is that the freight rates on the entire traffic will be substantially the same as though all of it went by water. It is from this point of view that the real importance of the river must be judged. The total actual reduction of freights, directly or indirectly accomplished, will nearly equal the cost of creating a suitable navigation, and the saving on the traffic that will actually use the improvement would pay a return on several times its cost.

A military reason of some weight for making the proposed improvement is the provision of water carriage to the United States arsenal at Springfield.

By means of the canal of the Connecticut River, with the improved stretch below it and the Enfield pool above it, navigation between Holyoke and Hartford was carried on as long as competitive rates could be made by vessels small enough to pass the locks of the canal. That period practically terminated twenty years ago, although the canal has remained nominally open to navigation. Between the foot of the falls and Hartford some improvement was attempted and effected in the years 1871–1873 by building wing dams at the upper shoals and by dredging. The small measure of benefit realized, as compared with the development and cost of the works constructed, led to the conclusion that a radical open-river improvement of this stretch is impracticable.

In 1872 a plan was submitted for passing the Enfield Rapids by means of a lateral canal on the east bank, to be carried out in connection with the work then in progress on the river below the rapids. This plan was selected from several alternative schemes proposed and discussed. Full information as to all of these may be found in the Report of the Chief of Engineers, 1878, pages 278–290. In the following year, 1873, the great difficulty of improving the part of the river between Hartford and the rapids was recognized in the presentation of a revised

project for continuing the lateral canal to the mouth of Hockanum River, below Hartford. The proposed canal was given a width of 150 feet and a depth of 10 feet in the trunk, with locks of 200 feet length, 55 feet width, and 8 feet depth on the sills. The estimated cost at that time was $2,306,345. In 1880 the project was revised, and by reducing the width of trunk to 120 feet and taking a much lower unit cost of earth excavation the estimate was reduced to $1,322,805.

A careful study of the subject justifies the statement that this canal, though in some respects unsatisfactory, represented the best solution then possible of the problem of providing a secure and commodious water route from Hartford to Holyoke. That a solution possessing all the advantages of that one, and obviating most of its defects, can now be offered is due solely to the advance in the science of river engineering between that date and this.

The present transportation facilities of the tributary district are such that purely local water carriage can scarcely become competitive in any general sense. A water route, to make its influence felt as a factor in transportation, must permit extension to Springfield and Holyoke of the present traffic below Hartford. This criterion demands a depth of 9 feet at extreme low water, a channel width of not less than 150 feet at the same stage, and no obstacles to the passage of the largest vessels now navigating the lower Connecticut River. A local traffic will doubless thrive on such a route, but will not justify its creation.

In addition to the requirements of navigation, there are certain vested rights in the development of water power from the stream which deserve and demand consideration. They could be purchased and destroyed, it is true, but the destruction of cheap power is in itself inimical to progress, and any plan which promotes the usefulness of the stream in one direction by destroying its value in another must be considered seriously defective. The full benefit of the river can be realized only by developing and conserving every profitable use which can be made of it. For these reasons the complete preservation and protection of the existing power installations has been made an essential condition of any plan to be proposed. The present installations are at Holyoke and Windsor Locks. Their interests demand that the available power shall not be diminished, either by lowering the head water, by raising the tail water, or reducing the quantity of water available.

All these conditions and requirements combined point to a slack-water improvement by means of locks and movable dams as the most promising solution of the problem. The details of such an improvement have been studied far enough, and only far enough, to demonstrate its feasibility, and to determine its effect upon the various interests involved. It is proposed to build three locks and movable dams, and to excavate where required to make a channel 150 feet wide and 9 feet deep below pool level. The first or upper dam is provisionally located in the east branch of the river at Kings Island, the west branch to be closed by a fixed dam. This site is 20.85 miles from Holyoke, and 3½ miles below the present Enfield Dam. The crest of this dam has an elevation of 39 feet above low water at Hartford, and the normal pool level maintained by it is the same as that of the present Enfield pool. The second dam is 22 miles from Holyoke, giving a length of pool of 1.15 miles and a pool level of 26½ feet. The third dam is located just below the highway bridge at Hartford, giving a pool length of about 13 miles and a normal pool level of 8 feet. This pool connects with the channel, now maintained by dredging, from Hartford to Long Island Sound. On the maps and profile accompanying this report the scheme proposed is shown with sufficient definiteness for present purposes.

The effect of these dams upon the river itself may be briefly stated. The crest of the upper dam is very near extreme flood level. The survey indicates that a small area—a few acres at most—on and opposite Kings Island will be permanently overflowed, and will require compensation for flowage. As the river rises the dam will be gradually lowered so as to keep the pool level at the head of Kings Island constant, for reasons to be given later. As this level is nearly that of highest water, it follows that the dam will rarely be entirely down, and that there will be lockage at this dam at all stages short of extreme flood. If Enfield Dam be wholly removed, which may be done if desired, the extreme flood plane will be lowered, beginning at Willimansett and reaching a maximum of probably 5 feet at Thompsonville. A removal of part of Enfield Dam will produce a proportional lowering of the planes of moderate and extreme floods. The second dam will be so manipulated as to maintain a nearly constant pool level. It causes no flowage, and as it will be entirely down at about 70,000 cubic feet per second of discharge, it exercises no influence at all on the higher stages, nor will the lock be used at such stages. The third dam must be manipulated to closely control the pool level, which is below the natural bank, and hence causes no flowage. This dam will be entirely down when the level of natural flow is at its crest, which corresponds to about 30,000 cubic feet per second of discharge. The upper dam will have to be operated during suspension of navigation; the other two will not.

The second dam has no effect on the power plants at Holyoke or Windsor Locks, and need not be considered in that connection. The upper dam controls the tail water of the Holyoke mills and the head water of those at Windsor Locks, and its effect on each has been the subject of careful study. The effect on the tail water at Holyoke is due to the substitution of a movable for a fixed dam, pooling the water at the same level at least discharge. As the river rises the depth on the fixed Enfield Dam increases, and the level of the pool rises, raising by so much the tail water at Holyoke. With a movable dam the effective crest will be depressed as the river rises, keeping the pool at normal level until the surface of natural flow surpasses that level. In this particular case, as has been seen, the control of the pool extends to a discharge of 70,000 cubic feet per second, or an elevation of surface at Thompsonville of 46 feet above the Hartford zero. Complete tables of the duration of different stages at Hartford for the seven years, 1871–1877, are given in the Warren-Ellis report (Report of the Chief of Engineers, 1878, page 366 et passim), and are consolidated in a table of this report. Averaging these, and assuming the same duration of similar stages above Enfield Dam, a simple computation will show that under the new conditions the water at Thompsonville will probably be lower than now for the periods of each year and by the amounts set forth below—

Number of days in each year.	Number of feet that water surface at Thompsonville will be lower than now.
117	1
48	2
29	3
19	4
17	5
11	6
241	.....

giving, after a proper correction for the steeper slope of higher stages has been applied, a total of 241 days in each year during which the tail water at Holyoke will be lowered from 1 to 4 feet. During the rest of the year it will be practically unaffected.

The effect on the head water of the Windsor Locks mills will next be considered. The canal of the Connecticut River Company now leaves the river above the Enfield Dam. The normal pool level at this point is 39 feet above the Hartford zero. The proposed plan carries this pool farther downstream, so that the canal under the new conditions can head a mile and a half farther down with the same pool level. The new entrance to the canal will be at the fixed dam at the head of Kings Island, 20.2 miles from Holyoke. The present level of the surface of the canal at this point is 37.82 feet above the Hartford zero. The pool level here will be 39 feet above the same datum, so that the water surface will be 1.18 feet higher than now. If the same flow be assumed, the water will be higher at the mills by the same amount; or, if the gain be added to the slope, the other conditions remaining the same, the volume of water reaching the mills will be 50 per cent greater than now. These two benefits may be combined as desired. If the Windsor Locks mills use no more water than now, they can have it at a higher elevation, or they can use 50 per cent more than now without losing any head. The part of the canal thrown out is the most difficult to maintain, as the strain on its embankment during freshets is severe. At such times the actual entrance to the canal is near where it is now proposed to place it permanently, as stop gates are placed there to raise the water behind the embankment for its protection.

The third pool controls the tail water of these mills, and the net effect upon their available power results from a combination of the new head and tail water conditions. With the crest of the third dam at 8 feet above datum, the tail water at the lower mill at Windsor Locks will be a few inches higher than now at extreme low water. But the effect on the mills above is less, and the difference for all disappears at about 8,000 cubic feet per second of discharge, except for the lowest, for which the difference disappears at about 20,000 cubic feet discharge. Assuming that the headwater at the lowest mill remains the same and that the superelevation at the head of the canal is used to increase the slope and discharge, a preliminary computation indicates that the minimum actual head of water at the lowest mill will be a foot less than the present; at the next mill, 6 inches less, and at the higher mills substantially unchanged. The discharge of water will be increased 50 per cent and the aggregate power available from the present canal will be increased in nearly the same ratio.

If, on the other hand, the volume of water used remain as now and the superelevation at the head of the canal be transferred to the foot, the heads at all the mills except the lowest and at all stages will be greater than now. At the lowest mill the head will be unchanged at extreme low water and will be greater at higher stages.

The proposed project will not reduce the quantity of water available for the present canal. The difference between the minimum flow and the maximum prospective consumption of the Windsor Locks wheels is ample to supply the lockage and leakage through the dam. The maximum amount required for lockage is relatively small, not exceeding 200 cubic feet per second, and the dam can be made so tight as to reduce the leakage to a small volume.

As already intimated, the proposed plan for making the river itself navigable avoids some objections to a lateral canal. It may be urged

against lateral canals generally that they substitute at all seasons an artificial and restricted channel for a natural and less restricted one. A canal trunk is much more difficult to navigate than a cut of the same width made in the bed of a river. The possible speed is less in the canal trunk, and the consolidation of the banks to permit even moderate speeds is a matter of difficulty and cost, which is avoided in the case of a natural channel artificially deepened. In cold climates the canal is closed by ice sooner than the river, and opens later. There is a probability of suspensions of navigation in a canal by accidents to the trunk, which is not the case in a natural channel.

For this particular case, assuming, as has already been done, that the location proposed by General Ellis is the best for a lateral canal, it appears that the canal is practically a through route from Hartford to Thompsonville. Its benefits between the points named are limited to a narrow belt on one side of the river. From the district on the other bank, including the important town of Windsor Locks, the canal is separated by the river itself. A river navigation makes it possible to reach every point on both banks, and serves the entire district to which the river is tributary.

So far as the mechanical features of the dams are concerned the proposed project is pronounced feasible in view of the fact that the Chanoine type of dam, a fully established construction, can be used at all the sites, if found necessary. That type is the most costly and not the most suitable for the upper dam, which must be operated frequently to give the necessary control of the pool, and must be kept in operation while navigation is suspended. A dam of the bear-trap type is better adapted to the situation, as it is tighter and can be operated more rapidly and with less labor, and without interference from ice or drift. It is thought better, moreover, to control the pool by a slight movement of a long crest than by throwing part of the dam entirely, leaving the rest up, as would have to be done if the Chanoine dam were adopted.

At the second and third sites the objections to the wicket dam are less weighty, as these dams do not have to be operated during the suspension of navigation, and the second has to be operated much less frequently than either of the others since its pool does not require close control. For the first and second dams the conditions are favorable to the bear trap, since the slope is steep at all stages, and by supplying the hydraulic chamber of the dam through a conduit extending a short distance upstream the initial head for starting the gate will never be wanting. Such is not the case at the third dam, and a bear trap, to work properly there, must be provided with extraneous power to start the gate up, a problem not as yet satisfactorily solved, though by no means improbable of solution.

The ruling dimensions provisionally adopted as a basis of estimate are for locks 260 feet working length, 45 feet width, and 10 feet depth on the sills. The excavated channel has been reckoned at 150 feet bottom width and 9 feet deep below the pool level, taken as horizontal and at the crest of the dam. The greater depth on the sills is precautionary to permit the increase of channel depth to 10 feet at the cost of excavation only, should the development of commerce demand such increase. The depth of 10 feet is that provided in the river below Hartford at the ordinary summer stage, the prevailing one during the season of navigation. The arrangement proposed secures the standard depth throughout the pools when the discharge of the river is a minimum and the pools are practically level. At higher stages, when there is a slope in

the pools, there will be greater depth in the upper part of each pool, but no more at the first and third dams, since it is a part of the project to keep the pools at these points at a constant level as long as possible. The part of each year when the pools can not be so controlled is so short and so uncertain that no provision need be made for increased depth at such times, since it is not reasonable to suppose that any vessels would be prepared to take advantage of it. Hence the sills of the navigable passes can be kept up to a reference which will permit a draft of 10 feet over them when the dams are down, provided a lower reference is not required to prevent engorgement. This question is one for detail study rather than a general project. But it has been ascertained by an inquiry directed to that purpose that the sites which would probably be selected for the dams have sections of natural engorgement a short distance above or below them, so that a moderate retrenchment of area at the points selected will not raise the flood line. By holding the sills well up the desired effective height of dam is secured without unusual dimensions in the movable weir.

The sites of the dams provisionally located have already been given. The lifts can not be equally divided, as would seem the natural procedure, on account of the restrictions as to pool levels of Nos. 1 and 3 and the irregular profile of the stream. The first pool is given the level which harmonizes the power interests. The third pool is placed as low as possible, with the same object in view, and the middle pool is placed as high as possible, to minimize the rock excavation, which mostly occurs there. Under these restrictions and conditions the levels and maximum lifts are as follows:

	Feet.
Level of first pool	*39
Lift of first lock	12½
Level of second pool	*26½
Lift of second lock	18½
Level of third pool	*8
Lift of third lock	8

These lifts correspond to extreme low water. At all higher stages the lift at each lock will be less by the fall of the surface through the pool below it. For a discharge of 40,000 cubic feet per second, for example, a vessel can pass from Hartford to the upper pool through a rise of water surface of 28½ feet, with two lockages aggregating 16½ feet, the third dam being down.

Estimates.—The available data, though unusually elaborate and complete, considered as a general survey of the river, are still insufficient as a basis for detail estimates of the cost of the structures proposed on the sites provisionally selected. The locks in view are of the usual type, with mitered gates maneuvered by hand; but the fact that the locality supplies stone for good masonry makes the character of construction to be adopted depend on local inquiry, and possibly on alternative bids. It is necessary to base preliminary estimates upon actual experience with similar constructions in other localities. Data obtained from trustworthy sources are used, and the figures given below are believed to be adequate and to be in excess rather than in defect of the probable actual cost. The lock sites will be in the river bed, but a small plat of ground is required adjacent to each for use in construction and maintenance and to extinguish riparian rights. For the same reasons a small plat is required adjacent to each abutment. There is very little flow-

* Above Hartford zero

age to be taken into consideration, and there is no apparent basis for any claim of any character arising from the changed regimen of the stream. So far as can be foreseen, every interest that is affected at all is benefited.

Cost of three locks, at $100,000	$300,000
Cost of 2,500 feet movable dam of bear-trap type, at $200 per foot	500,000
Cost of fixed dam at Kings Island	50,000
Cost of land, flowage, buildings, and contingencies	225,000
Total of locks and dams	1,075,000
Excavation of sand and gravel, 600,000 cubic yards, at 25 cents	150,000
Excavation of rock, 200,000 cubic yards, at $3	600,000
Total	1,825,000

If Chanoine dams be used the cost of dams per foot may be taken at $300, and the grand total above will be increased to $2,075,000, which may be considered as the maximum cost of project. In addition to the first cost as above set forth there would be involved, if this project were adopted, a cost of maintenance, including the operation of the locks and dams, the necessary repairs to the same, and the small amount of dredging possibly required to keep open the artificial cuts. This may be estimated approximately at $8,000 per annum.

In view of this estimate of cost and the commercial importance of the stream, as set forth above, I am of the opinion that the Connecticut River between Hartford and Holyoke is worthy of improvement by the General Government in the manner and to the extent herein set forth.

Very respectfully, your obedient servant,

SMITH S. LEACH,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

(Through the Division Engineer.)

[First indorsement.]

NORTHEAST DIVISION ENGINEER OFFICE,
New York, November 20, 1897.

Respectfully forwarded to the Chief of Engineers.

The present project for the improvement of the Connecticut River contemplates 9 feet depth at extreme low water from Saybrook Bar to Hartford, a distance of 50 miles, approximately. The range of tides at Hartford is 1 foot, approximately. From Hartford to Windsor Locks, a distance of 11 miles, the river is open to navigation, but the depth on many bars being only 2 to 3 feet at mean low water, traffic during the low-water periods is necessarily confined to boats of light draft. At Windsor Locks the Enfield Rapids, 5 miles long, carried over a rocky bed with a fall in that distance of 33 feet, approximately, at low stage, are first met, and transportation around them is provided by a private canal of small capacity, on the west bank, built under a charter granted in 1824. This canal accommodates boats only 80 feet long by 18 feet wide and 3 to 4 feet draft.

In 1872 the local officer submitted a plan to extend navigation 18 miles farther upstream to Holyoke, Mass., by a canal, with locks and dams around the rapids, on the east bank, extending from the upper pool to deep water in the river below, of practically the same length as the private canal on the west bank, to be used in connection with

improvements by wing dams and dredging then in progress in the river below the rapids. As the river works did not prove satisfactorily successful, the local officer modified his plans in 1880 by recommending that the canal start at the mouth of the Hockanum River, just below Hartford, and extend to the pool above the falls, a total length of over 16 miles, at an estimated cost of $1,300,000. The proposed canal was to have a width of 120 feet and a depth of 10 feet in the trunk, with locks of 250 feet length, 55 feet width, and 8 feet depth over the miter sills.

Major Leach now proposes to substitute for the plans of 1880 others providing for a slack-water improvement of the river past the rapids by means of three locks and three movable dams, at the maximum estimated cost of $2,000,000, which he states may be effected with advantage to navigation at all stages and without injury to the canal on the west bank or the water power now used by the industrial enterprises centered at Windsor Locks and Holyoke. The bottom width of the canal will be 150 feet and the depth 9 feet, and the locks 260 feet long and 45 feet wide, with 10 feet depth on the sills.

The local officer has carefully studied the natural conditions of the river and the necessities for its improvement, and his conclusions are clearly and concisely expressed.

The plans appear to be feasible, and I respectfully state that, in my opinion, the Connecticut River between Hartford and Holyoke is worthy of improvement by the General Government in the manner and to the extent set forth in Major Leach's report dated November 13, 1897.

G. L. GILLESPIE,
Colonel, Corps of Engineers, Division Engineer.

D 18.

SURVEY OF SOUTH NORWALK HARBOR, CONNECTICUT.

[Printed in House Doc. No. 129, Fifty-fifth Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 6, 1897.

SIR: I have the honor to submit the accompanying report, dated November 30, 1897, by Maj. Smith S. Leach, Corps of Engineers, concerning a survey of the harbor of South Norwalk, Conn., provided for by the terms of the river and harbor act of June 3, 1896.

The harbor of South Norwalk is a part of Norwalk Harbor, being that portion of the Norwalk River between the city of South Norwalk and Long Island Sound. The approved project for improving Norwalk Harbor consists in removing the shoal at Ferrys Point to a depth of 6 feet at mean low water, in making a channel to South Norwalk 150 feet wide and 10 feet deep at mean low water, and in widening the two bends at the harbor entrance.

Major Leach recommends that present project for the improvement of Norwalk Harbor be amended by including therein a branch channel to East Norwalk 60 feet wide and 6 feet deep at mean low water, estimated to cost $5,760; by deepening the present channel above the railroad bridge to 8 feet at mean low water, at an estimated cost of $13,200, and by maintaining the project dimensions of channel over the entire harbor, at an estimated cost of $2,500 per annum.

In the opinion of the local officer, the harbor of Norwalk is worthy of improvement by the General Government in the manner and to the extent set forth, and his views and recommendations are concurred in by the division engineer, Col. G. L. Gillespie, Corps of Engineers.

Very respectfully, your obedient servant,

JOHN M. WILSON,
Brig. Gen., Chief of Engineers,
U. S. Army.

Hon. R. A. ALGER,
Secretary of War.

REPORT OF MAJ. SMITH S. LEACH, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
New London, Conn., November 30, 1897.

GENERAL: I have the honor to submit the following report upon the survey of the harbor of South Norwalk, Conn., authorized in the river and harbor act of June 3, 1896, and directed to be made by Department letter dated September 5, 1896. Inasmuch as a complete instrumental survey of Norwalk Harbor was made in 1894, and published with a large map in House Document No. 50, Fifty-fourth Congress, first session, no field work was considered necessary in connection with this report. The harbor of South Norwalk, as named in the act cited, is a part of Norwalk Harbor, as surveyed and mapped in 1894, being that portion of the channel between the city of South Norwalk and the Sound.

The extension of the project recommended in the report on the 1894 survey related entirely to the South Norwalk part of the harbor, and provided for a depth of 10 feet at mean low water, and a width of 250 to 300 feet at the sharp bends and 150 feet elsewhere. So far as can be learned by inquiry of parties who have been active in forwarding this improvement, the project, so far as it relates to South Norwalk, is satisfactory, and nothing but its reasonably prompt execution is desired.

It does not seem probable that Congress intended to confine this inquiry to the locality which the literal reading of the act indicates and for which a liberal project had just been reported. A more reasonable supposition is that Congress had especially in view the parts of Norwalk Harbor which were not included in the last enlargement of the project. Upon this supposition inquiries have been made as to the adequacy of all parts of Norwalk Harbor to the demands of commerce, and the results are herein reported.

At East Norwalk, opposite South Norwalk, and below the railroad bridge, there is 300 feet of dock front, and it is proposed to build as much more. There was a traffic last year of 6,820 tons of coal, sand, brick, lumber, and oysters. Four schooners loaded with lumber were discharged at South Norwalk and their cargoes rafted across, because there was not sufficient water for the vessels to reach the East Norwalk dock loaded.

No work has been done in the East Norwalk channel. In its natural condition it is regular in trace, 60 to 75 feet wide, and averages 1 foot deep at low water. The navigable depth is substantially the tidal rise, which is a fraction over 7 feet. The length of channel to be operated upon is 3,000 feet, and it is thought that a width of 60 feet and a low-water depth of 6 feet will meet all reasonable demands. The yardage involved is 48,000, and its cost, including administration, will probably

be 12 cents a yard, making the estimate of the cost of this part of the project $5,760.

For the main channel above the railroad bridge, between South Norwalk and Norwalk, the present depth, obtained by dredging, is 6 feet at mean low water, with widths of 60 to 100 feet. The length of this channel is 8,000 feet. The present project contemplates maintaining this depth. The annual traffic above South Norwalk, from reports made by shippers, perhaps not exhaustive, consists of 356 round trips of steamboats, drawing 9 feet; 40 round trips of sailing vessels, drawing 10 to 11 feet, and 81 round trips of barges, drawing 7½ to 9 feet. The total tonnage is estimated at 71,925. The tonnage reported for the whole harbor for the calendar year 1896 is 146,000, from which it would appear that nearly half of the whole traffic uses the channel above the bridge. In view of this fact and the actual draft of vessels noted above, the disparity in depth of 10 feet below and 6 feet above the bridge seems unduly great, and a better-balanced project would undoubtedly result from increasing the latter to 8 feet. The width should be 60 feet in the straight portions, increased to 100 feet at the bends. On this basis, to deepen the channel above the bridge to 8 feet at mean low water will involve 80,000 cubic yards of dredging which, taken at 16½ cents, to include administration and contingencies, will cost $13,200.

I have the honor to recommend that the present project for the improvement of Norwalk Harbor, Connecticut, be amended by including therein a branch channel to East Norwalk 60 feet wide and 6 feet deep at mean low water, at an estimated cost of $5,760; by deepening the present channel above the railroad bridge to 8 feet at mean low water, at an estimated cost of $13,200, and by maintaining the project dimensions of channel over the entire harbor, at an estimated cost of $2,500 per annum.

In my opinion, the harbor of Norwalk, Conn., is worthy of improvement by the General Government in the manner and to the extent set forth.

Very respectfully, your obedient servant,

SMITH S. LEACH,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.
(Through the Division Engineer.)

[First indorsement.]

NORTHEAST DIVISION ENGINEER OFFICE,
New York, December 2, 1897.

Respectfully forwarded to the Chief of Engineers.

In view of the facts herein given relative to the commerce of Norwalk Harbor, included between South Norwalk and Norwalk, and to that existing at East Norwalk, but now hampered by inadequate water facilities, it is recommended that the present project for the improvement of Norwalk Harbor, Connecticut, be amended as herein recommended by the district officer.

The opinion expressed by the district officer, that the harbor of Norwalk, Conn., is worthy of improvement by the General Government in the manner and to the extent set forth in his report dated November 30, 1897, is also concurred in.

G. L. GILLESPIE,
Colonel, Corps of Engineers, Division Engineer.

APPENDIX E.

IMPROVEMENT OF BAY RIDGE, RED HOOK, AND BUTTERMILK CHANNELS, NEW YORK HARBOR, AND OF RIVERS AND HARBORS IN NEW YORK ON LONG ISLAND SOUND AND ON SOUTHERN SHORE OF LONG ISLAND.

REPORT OF MAJ. H. M. ADAMS, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1898, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Port Chester Harbor, New York.
2. Mamaroneck Harbor, New York.
3. East Chester Creek, New York.
4. Bronx River, New York.
5. Mattituck Harbor, New York.
6. Port Jefferson Harbor, New York.
7. Huntington Harbor, New York.
8. Glencove Harbor, New York.
9. Flushing Bay, New York.
10. Patchogue River, New York.
11. Browns Creek, Sayville, New York.
12. Canarsie Bay, New York.
13. Bay Ridge, Red Hook, and Buttermilk channels, New York.
14. Gowanus Creek Channel, New York.
15. Newtown Creek, New York.
16. Removing sunken vessels or craft obstructing or endangering navigation.

HARBOR LINES.

17. East River at Long Island City, New York, from the canal of the Devoe Manufacturing Company to Newtown Creek.
18. Brooklyn side of East River, New York, from the Hamilton avenue to the New York and Brooklyn Bridge.

UNITED STATES ENGINEER OFFICE,
New York City, July 15, 1898.

GENERAL: I have the honor to transmit herewith annual report upon works of river and harbor improvement in my charge for the fiscal year ending June 30, 1898.

Very respectfully, your obedient servant,

H. M. ADAMS,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

E 1.

IMPROVEMENT OF PORT CHESTER HARBOR, NEW YORK.

Port Chester Harbor is on the boundary line between the States of New York and Connecticut; it consists of the tidal part of Byram River and of a bay at its mouth.

PROJECTS FOR IMPROVEMENT.

In 1872 a project for improvement was adopted, which, as subsequently modified, consists in removing Salt Rock to 9 feet below mean low water, building a breakwater from Sunken Rock to Byram Point, and dredging to make and maintain a channel to the Port Chester wharves, at a total cost of $57,000.

At the beginning of the past fiscal year this project had been completed, except the dredging in the upper harbor.

Detailed descriptions of the harbor and of the project for improvement are printed in the Annual Report of the Chief of Engineers for 1897, page 1084.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

No work was done.

PRESENT CONDITION OF IMPROVEMENT.

Salt Rock has been removed to a depth of 9 feet below mean low water. The breakwater has been built from Sunken Rock to high-water mark on the rocks at Byram Point, leaving a gap 30 feet wide near the shore end, to allow small boats to pass through at high tide. The end of the breakwater has been built up to 15 feet above low water, to serve as beacon upon Sunken Rock.

A channel has been dredged from deep water in the bay to the steamboat landing at Port Chester, a distance of about 6,300 feet, with depth of 8 feet at mean low water and width of 75 feet up to Town Dock, and above that point with depth of 6 feet at mean low water and width of 60 feet; at the bend at the steamboat landing the width was made 100 feet. Above the steamboat landing the depth is 2½ feet at mean low water.

PROPOSED OPERATIONS.

Future appropriations should be applied to maintaining, extending, and widening the channel.

Port Chester Harbor is in the collection district of New York. The nearest lighthouse is on Great Captains Island, 1¼ miles east of the mouth of the harbor. The nearest works of defense are the fortifications on Davids Island, New York, 9 miles to the southwest.

Money statement.

July 1, 1897, balance unexpended	$186.55
June 30, 1898, amount expended during fiscal year	186.55
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

Appropriations for improving Port Chester Harbor, New York, have been made as follows:

Application.	Date.	Amount.
Removing Salt Rock	June 10, 1872	$12,000
Dredging in Byram River and Bay	Aug. 2, 1882	15,000
Breakwater	Aug. 11, 1888	5,000
Do	Sept. 19, 1890	5,000
Do	July 13, 1892	5,000
Breakwater and dredging	Aug. 18, 1894	5,000
Dredging 6 feet depth	June 3, 1896	5,000
Total		52,000

No contract for this improvement has been in force during the past fiscal year.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1897.

Arrival and departure of vessels.

	Number of round trips.	Draft.	Tonnage.
		Feet.	*Tons.*
Steamers	160	8	268
Steam tugs	345	5 to 8	10 to 60
Sail vessels	95	6 to 13	40 to 400
Barges	240	8 to 10	100 to 500
Total	840	.....	.....

Freight received and shipped by water.

	Tons.	Estimated value.
Receipts:		
Coal	35,400	$158,800
Building materials	19,600	88,200
Miscellaneous	41,025	1,230,000
Total	96,025	1,477,000
Shipments:		
Farm produce	4,050	91,000
Manufactured goods, etc	18,875	2,070,000
Total	22,925	2,161,000

The above figures show an increase of 4,201 tons in amount of freight over that reported for 1896.

No new lines of transportation have been established since July 1, 1897.

E 2.

IMPROVEMENT OF MAMARONECK HARBOR, NEW YORK.

Mamaroneck Harbor, on the north shore of Long Island Sound, about 5 miles west from the Connecticut State line, consists of an open shallow bay and a narrow tidal inlet about a mile long.

The channel to the old steamboat wharf (about halfway up the inlet) had a depth of 5 feet at mean low water. From there to the upper wharves the depths gradually decreased to 1 foot. At and near its mouth the inlet was obstructed by several rocks.

The mean rise of tide at Mamaroneck is about 8 feet.

PROJECT FOR IMPROVEMENT.

A survey of the harbor was made in 1881, in pursuance of the river and harbor act of that year, and a project for improvement was submitted, and under the river and harbor act of 1882 was adopted. This project consisted in removing Round Rock, in the upper channel, to a depth of 4 feet at mean low water; in removing five other rocks (Bush Rock, part of Nells Rock, Inner Steamboat Rock, Outer Steamboat Rock, and Little Nanhook) to a depth of 7 feet, and in dredging a channel 7 feet deep and 100 feet wide from Long Island Sound to the old steamboat wharf, and thence 4 feet deep and 80 feet wide to the upper wharves, together with the closing of a small channel east of "Grassy Knoll," at a total estimated cost of $43,000.

Under appropriations made in 1882 and 1896 Round Rock was removed to 4 feet below mean low water, and Bush and Inner Steamboat rocks to 7 feet depth, and a channel 60 feet wide and 6 feet deep at mean low water was dredged to the upper steamboat dock (a distance of about 3,000 feet) and was extended 200 feet farther with 35 feet width.

A sketch of Mamaroneck Harbor was printed in the Annual Report of the Chief of Engineers for 1886, page 658.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

No work was done.

PRESENT CONDITION OF IMPROVEMENT.

Round Rock has been removed to a depth of 4 feet at mean low water, and Bush and Inner Steamboat rocks to 7 feet depth.

A channel 6 feet deep at mean low water has been dredged from deep water to the upper steamboat dock, 60 feet wide, and extends 200 feet farther up the harbor with 30 feet width.

PROPOSED OPERATIONS.

Future appropriations should be applied to maintaining and widening the dredged channel.

Mamaroneck Harbor is in the collection district of New York. The nearest lighthouse is on Execution Rock, about 4 miles south. The nearest works of defense are the fortifications on Davids Island, New York, 5 miles to the south-southwest.

Money statement.

July 1, 1897, balance unexpended	$60.54
June 30, 1898, amount expended during fiscal year	60.54
Amount (estimated) required for completion of existing project	18,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

Appropriations for improving Mamaroneck Harbor, New York, have been made as follows:

Application.	Date.	Amount.
Removal of rocks	Aug. 2, 1882	$15,000
Dredging	June 3, 1896	10,000
Total		25,000

No contract for this improvement has been in force during the past fiscal year.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1897.

Arrivals and departures of vessels.

Kind of vessel.	Number of round trips.	Draft.	Tonnage.
		Feet.	*Tons.*
Steamers (2)	150	7 to 8	54 to 113
Steam tugs (5)	90		
Sail vessels	6	7 to 9	120 to 200
Barges, canal boats, etc	90	7 to 9	100 to 650
Total	336		

Freight received and shipped by water.

Articles.	Received.		Shipped.	
	Tons.	Estimated value.	Tons.	Estimated value.
Coal	11,800	$47,200	.....	.....
Building materials	6,873	68,730	.....	.....
Crushed stone	9,000	11,250	.....	.....
Railroad ties, iron, and miscellaneous	21,000	630,000	3,000	$120,000
Total	48,673	757,180	3,000	120,000

The total tonnage of above commerce, 51,673 tons, is greater than that reported for 1896 by 19,578 tons.

No new lines of transportation are reported established since July 1, 1897.

E 3.

IMPROVEMENT OF EAST CHESTER CREEK, NEW YORK.

East Chester Creek is a small tidal stream which empties into Long Island Sound just east of Throgs Neck and 20 miles by water from the Battery, New York City.

PROJECTS FOR IMPROVEMENT.

In 1873 a project for improvement was adopted, which has since been modified and consists in making a channel 100 feet wide and 9 feet deep at mean high water (about 2 feet at low water), extending from Pelham Bay up the stream to 3,000 feet above Lockwoods, and in removing rocky obstructions from the mouth of the creek.

July 1, 1897, this project was nearly completed; there remained only the widening of the channel between Town Dock and Lockwoods by dredging and removing a small amount of rock.

A detailed description of the stream and of the project for improvement is printed in the Annual Report of the Chief of Engineers for 1897, pages 1089–1090.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

At the beginning of the year a contract for dredging and rock excavation was in force, entered into with James McSpirit under date of June 7, 1897, and expiring October 1, 1897. The contract provided for removing about 16,515 cubic yards of material at prices, for sand, 41 cents per cubic yard; for loose rock and sand mixed, $1.09 per cubic yard; for solid rock, $19 per cubic yard.

Work under this contract was begun July 14 and completed September 22, 1897. The total amount of material removed was 14,869¼ cubic yards, of which 12,960 cubic yards were sand and mud, 1,843 cubic yards were loose rock and sand mixed, and 66¼ cubic yards were solid rock.

The channel from 100 feet above Town Dock to the highway bridge at Lockwoods, a distance of about 3,000 feet, was widened by a cut on the west side and by parts of other cuts in the middle where shoals were found, and ledge rock was removed from the west cut at about 1,400 feet above Town Dock and at 300 to 700 feet below Lockwoods. The channel was made 90 to 100 feet wide, and 9 feet deep at mean high water, equivalent to 2 feet at low water.

PRESENT CONDITION OF IMPROVEMENT.

The channel has been made 9 feet deep at mean high water and about 100 feet wide from Pelham Bridge to a point 3,000 feet above Lockwoods. It is in good condition.

The dikes on the east side of the cut below Lockwoods, built in 1877–78, show some deterioration. No repair is necessary at present.

PROPOSED OPERATIONS.

The project for this improvement is considered completed; no further work is proposed.

An act of Congress approved February 17, 1897, authorized the Secretary of War, in his discretion, to expend the whole or any portion of any appropriation theretofore made for the improvement of East Chester Creek "upon that portion of the improvement included in recent surveys extending the improvement to the head of tide water." When the improvement of the channel below Lockwoods was completed, it was found that the balance of funds remaining was too small to effect any useful result upon the extension, and, with approval of the Secretary of War dated October 6, 1897, it was decided not to apply the funds to that purpose at present.

East Chester Creek, New York, is in the collection district of New York. The nearest light-house is on the "Stepping Stones," 3 miles southeast of the mouth of the creek. The nearest work of defense is Fort Schuyler, Throgs Neck, about 3¼ miles south.

Money statement.

July 1, 1897, balance unexpended	$10,384.74
June 30, 1898, amount expended during fiscal year	9,373.84
July 1, 1898, balance unexpended	1,010.90

Appropriations for improving East Chester Creek have been made as follows:

Application.	Date.	Amount.
Cutting through marsh and rock and diking (in 1877)	Mar. 3, 1873	$25,000
Dredging under Boston Road Bridge and at Goose Island	Mar. 3, 1875	12,000
Dredging near Lockwoods, Goose Island, and Pelham Bridge	June 18, 1878	10,000
Dredging, from 40 to 90 feet wide, from Pell Point to Town Dock	Mar. 3, 1879	3,500
	June 14, 1880	3,500
Dredging above Town Dock	Aug. 5, 1886	10,000
Dredging above Lockwoods	Aug. 11, 1888	5,000
Do	Aug. 18, 1894	12,000
Dredging	June 3, 1896	10,000
Total		91,000

CONTRACT IN FORCE DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

Dredging and rock excavation: mud, sand, etc., about 15,000 cubic yards, at 41 cents per cubic yard, scow measurement; solid rock, about 15 cubic yards, at $19 per cubic yard, measured in place; loose rock, about 1,500 cubic yards, at $1.09 per cubic yard, measured in scows. Name of contractor, James McSpirit, of Jersey City, N. J.; date of contract, June 7, 1897; date of approval, June 15, 1897; date of beginning, July 14, 1897; date of completing work, September 22, 1897; date of expiration of contract, October 1, 1897.

COMMERCIAL STATISTICS.

Only incomplete data for 1897 have yet been obtained. The following statement for 1896 shows the commerce reported a year ago:

Arrivals and departures of vessels.

[Draft, 6 to 10 feet; tonnage, 200 to 300 tons.]

Steamers	544
Sail vessels	27
Barges	230
Total	801

Freight received and shipped by water.

Articles.	Tons.	Estimated value.
Coal	16,878	$84,390
Building materials	7,580	50,900
Miscellaneous steamer freights, ashes, asphalt, crushed stone, etc	70,470	2,063,896
Total	94,928	2,199,186

No new lines of transportation have been established since July 1, 1897.

E 4.

IMPROVEMENT OF BRONX RIVER, NEW YORK.

The Bronx River is a small stream which flows southwardly through Westchester County and discharges into the East River, New York, about halfway between Hell Gate and Throgs Neck. For the lower 3 miles of its course, from West Farms to the mouth, the river is a tidal stream, navigable at high water. This part of the Bronx River lies wholly within the boundaries of New York City. Excepting a small bay at the mouth, the stream is everywhere narrow, with widths ranging from 50 to 300 feet. The natural depth in the bay is about 4 feet at mean low water, decreasing to 1 foot or less at the West Farms Docks. A short distance above these docks there is a dam which wholly limits navigation.

The navigable part of the river is crossed by two bridges, both with draws; the lower one is a highway bridge, about 2¼ miles above the mouth of the bay; 600 feet above is the bridge of the New York, New Haven and Hartford Railroad, Harlem River branch.

The mean rise of tide in the bay is 6.6 feet; at West Farms it is 5.9 feet.

PROJECT FOR IMPROVEMENT.

The river and harbor act of 1880 provided for a survey of the Bronx River. The report on the survey presented plans for making a channel 30 feet wide and 4 feet deep, at an estimated cost of $42,000. No appropriation was made for beginning work.

A survey of the Bronx River was again made in compliance with the provisions of the river and harbor act of 1890, the report upon which, printed in the Annual Report of the Chief of Engineers for 1891, page 951, presented a project for improvement which was adopted under the terms of the river and harbor act of 1896. This project consists in dredging and removal of rock to make a navigable channel 4 feet deep at mean low water, to be 100 feet wide from the entrance (Strain place) to Barlow street, thence to Dongan street to be 60 feet wide, and

thence to the head of navigation at West Farms to be 50 feet wide, at an estimated cost of $85,985.

Harbor lines in the bay at the mouth of Bronx River were established by the Secretary of War January 9, 1891.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

At the beginning of the year the work of rock excavation and removal was in progress under a contract with Frank Pidgeon, dated September 28, 1896, and expiring under extension July 31, 1897. The contract provided for removal of about 1,300 cubic yards of rock, at $6.89 per cubic yard, so as to make a depth of 6 feet at mean low water, where the depth had been from zero to 4 feet.

The contract was subsequently extended to September 30, 1897, and was completed September 22, 1897, the total amount of rock removed being 1,250 cubic yards. The work done under the contract consisted in the removal of two ledges, one about 1,300 feet below the highway bridge at Westchester avenue and one just below that bridge, and of the removal of 125 linear feet of the lower part of a third ledge, about 200 feet above the bridge. These ledges projected from the east bank into and across the channel, and the maximum available depth over them was about 1 foot at low water.

The blasted rock was for the most part removed by a dredge employed for the purpose at different times. Toward the close of the work small pieces which projected above the required depth were removed by divers and a derrick.

PRESENT CONDITION OF IMPROVEMENT.

Three ledges lying within the 50-foot channel have been removed, from a point 1,300 feet below to 350 feet above the Westchester Avenue Highway Bridge, except immediately under and close to the bridge, making a depth of 6 feet at mean low water, where rock was found less than the projected depth of 4 feet. The channel depth up to that point, where the bottom is muddy, is about 3 feet. Above the railroad bridge, where no work has been done, the channel depth is from zero to 2½ feet.

PROPOSED OPERATIONS.

Future appropriations should be applied to dredging and rock removal proposed under the project.

The Bronx River is in the collection district of New York. The nearest lighthouse is on North Brother Island, about 2 miles west from the mouth of the river. The nearest work of defense is Fort Schuyler, Throgs Neck, New York.

Money statement.

July 1, 1897, balance unexpended	$7,501.09
June 30, 1898, amount expended during fiscal year	7,501.09
Amount (estimated) required for completion of existing project	75,985.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

The only appropriation made by Congress for this improvement is that of $10,000, made by the river and harbor act of 1896.

CONTRACT IN FORCE DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

Contract for rock removal: About 1,300 cubic yards, at $6.89 per cubic yard, solid; name of contractor, Frank Pidgeon, of Saugerties, N. Y.; date of contract, September 28, 1896; date of approval, October 12, 1896; date of beginning work, October 17, 1896; date of expiration, June 30, 1897, extended to September 30, 1897; date of completion of work, September 22, 1897.

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1897.

Arrivals and departures of vessels.

[Draft, 4 to 6 feet; tonnage, 85 to 300 tons.]

	Number.
Steamers	6
Tugs	1,350
Sail vessels	68
Barges, etc	607
Total	2,031

Freight received by water (no shipments).

Articles.	Tons.	Estimated value.
Coal	65,500	$241,750
Lumber	5,700	48,700
Building materials	54,380	183,150
Ice	12,000	30,000
General merchandise	1,730	22,425
Total	139,310	526,025

The above figures show an increase over the amount of freight reported for 1896 of 45,066 tons.

No new lines of transportation are reported as established since July 1, 1897.

E 5.

IMPROVEMENT OF MATTITUCK HARBOR, NEW YORK.

Mattituck Harbor is a tidal inlet on the north shore of Long Island, about 70 miles east from New York City.

PROJECT FOR IMPROVEMENT.

Under the river and harbor act of 1896 a project for improvement was adopted which consisted in making a channel to be 7 feet deep at mean low water and 100 feet wide at the entrance, thence to the mill-dam 80 feet wide, and extending it to the Mattituck village with a depth of 7 feet at high water and width of 80 feet, the entrance channel to be protected by parallel jetties, at a total estimated cost of $83,000.

No work has yet been done under this project.

Further details as to this harbor and the project for improvement are printed in the Annual Report of the Chief of Engineers for 1897, page 1095, and for 1891, page 843.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

Nothing has been done. The first work necessary under the project for this improvement is the construction of the parallel jetties to protect and fix the shifting channel. The construction of these two jetties was estimated to cost about $40,000, and the available funds would be sufficient to build about one-half of either, from which no benefit to navigation could result. Therefore, with approval of the Secretary of War, dated February 12, 1897, the project for the application of the funds provided for Mattituck Harbor was modified to permit of their retention until a sufficient sum is appropriated to complete at least one of the jetties.

PROPOSED OPERATIONS.

For the reason above stated no work is at present proposed.

Mattituck Harbor is in the collection district of New York. The nearest lighthouse is on Hortons Point, about 8 miles to the northeast. The nearest work of defense is Fort Hale, New Haven Harbor, Connecticut, about 25 miles northwest.

Money statement.

July 1, 1897, balance unexpended	$10,000.00
July 1, 1898, balance unexpended	10,000.00
Amount (estimated) required for completion of existing project	73,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

Appropriations for improving Mattituck Harbor, New York; $10,000, by act of June 3, 1896; not yet expended.

No contract in force during the past fiscal year.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1897.

No statement of amount of tonnage of freights by water has been received. The harbor in its present condition is navigated only by boats of very light draft, and even this is done with difficulty.

The greater part of the freighting to and from Mattituck, estimated at about 100,000 tons in 1896, is done by rail.

E 6.

IMPROVEMENT OF PORT JEFFERSON HARBOR, NEW YORK.

Port Jefferson Harbor is on the north shore of Long Island and about 50 miles east from New York City.

PROJECT FOR IMPROVEMENT.

In 1871 a project was adopted under which, in 1883, a channel 100 feet wide and 8 feet deep at mean low water had been dredged through the inlet, and riprap jetties had been built to protect the channel on either side.

In 1890 a project was adopted for enlarging the jetties and dredging the channel 200 feet wide and 10 feet deep; this was modified to provide for 12 feet depth by the terms of the river and harbor act of 1894.

July 1, 1897, both jetties had been partly enlarged, and a channel 160 to 180 feet wide and 12 feet deep at mean low water had been nearly completed.

Detailed description of the harbor and of the projects for improvement are printed in the Annual Report of the Chief of Engineers for 1897, page 1097.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

At the beginning of the year dredging was in progress under a contract with the Newburg Dredging Company, dated March 22, 1897, and expiring August 31, 1897.

The contract was completed July 2, 1898; the work done during the fiscal year consisted in dredging 1,138 cubic yards of sand and in completing the removal of a shoal spot in the dredged channel.

The total work done under the contract consisted in the removal of 28,420 cubic yards of sand and stones; the channel of 12 feet depth at mean low water was widened 60 feet, making its width 160 feet, and on the inner half of the bar an additional cut of 20 feet width was made.

PRESENT CONDITION OF IMPROVEMENT.

The east jetty is 1,390 feet long, part of the shore end being covered by sand which has drifted in; it is 6 feet above high-water level, and approximately 4 feet wide on top. The west jetty is 940 feet long; the outer 250 feet has been built up to about 4 feet above high water, with 4 feet top width; the inner part is about 2 feet above low water. Both jetties are rough and in an unfinished condition; they require building up, trimming, and filling out the side slopes.

The dredged channel, made 240 feet wide and 10 feet deep, has shoaled on the east side at the inner end and is now about 200 feet wide. The 12-foot channel, now 160 to 180 feet wide, lies within and on the west side of the 10-foot channel.

PROPOSED OPERATIONS.

With future appropriations it is proposed to repair and enlarge the jetties as provided for in the adopted project, and to maintain the dredged channel.

Port Jefferson is a port of delivery in the collection district of New York. There is a light-house on Old Field Point, 1½ miles west of the harbor entrance. Fort Hale, New Haven Harbor, Connecticut, 23 miles distant, is the nearest work of defense.

Money statement.

July 1, 1897, balance unexpended	$6,021.66
June 30, 1898, amount expended during fiscal year	5,242.45
July 1, 1898, balance unexpended	779.21
Amount (estimated) required for completion of existing project	95,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

Appropriations for improving Port Jefferson Harbor have been made as follows:

Application.	Date.	Amount.
For previous projects:		
East jetty	Mar. 3, 1871	$15,000
Do	June 10, 1872	15,000
East and west jetties	Mar. 3, 1875	15,000
East jetty and dredging	Aug. 14, 1876	6,000
East and west jetties	June 18, 1878	8,000
Dredging	Mar. 3, 1879	5,000
East and west jetties	June 14, 1880	3,000
East jetty	Mar. 3, 1881	4,000
Do	Aug. 2, 1882	8,000
Total for the previous projects		79,000
For the present project:		
Enlarging jetties and dredging	Sept. 19, 1890	25,000
Dredging 10 feet deep	July 13, 1892	10,000
Dredging 12 feet deep	Aug. 18, 1894	7,500
Under contract for dredging 12 feet deep	June 3, 1896	7,500
Total for present project		50,000
The total amount appropriated for this harbor since 1871 is		129,000

CONTRACT IN FORCE DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

Contract for dredging about 28,400 cubic yards, at 23¼ cents per cubic yard, measured in scows; name of contractor, Newburg Dredging Company, of Newburg, N. Y.; date of contract, March 22, 1897; date of approval, April 2, 1897; date of beginning work, May 13, 1897; date of expiration, August 31, 1897; contract completed, July 2, 1897; amount removed, 28,420 cubic yards.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1897.

Articles.	Tons.	Estimated value.
Receipts:		
Coal	7,240	$26,095
Lumber	3,132	45,500
Building materials	500	9,650
Grain	9,800	101,200
General merchandise	1,500	40,000
Total	22,172	222,445
Shipments:		
Flour	1,300	50,000
Farm produce	2,025	9,125
Total	a3,325	59,125

a Probably not complete.

Vessels engaged in above commerce.

Class.	Number of round trips.	Tonnage.	Draft.
		Tons.	*Feet.*
Steamers	a710	10 to 1,100	3 to 15
Sailing vessels	a1,200	15 to 1,250	4 to 14
Barges, etc	7	100 to 250	4 to 8

a About.

Vessels enrolled or licensed.

[Furnished by Customs Collector Frank Baylis.]

Class.	Number.	Aggregate net tonnage.	Aggregate gross tonnage.
Steamers	6	383	509
Sailing vessels	65	6,936.32	7,877.49

The above figures show a total of 25,497 tons of freight, which is less than the amount reported for 1896 by 6,203 tons.

No new lines of transportation are reported as established since July 1, 1897.

E 7.

IMPROVEMENT OF HUNTINGTON HARBOR, NEW YORK.

Huntington Harbor is on the north shore of Long Island, and about 40 miles east from New York City.

PROJECTS FOR IMPROVEMENT.

In 1872 a project was adopted under which in 1873 a shoal at the harbor entrance was removed and a channel 2,200 feet long, 130 to 150 feet wide, and 8 feet deep at mean low water was dredged up to the town landings.

In 1884 this channel had completely filled up.

In 1890 a project was adopted for restoring and maintaining this channel, at an estimated cost of $32,000.

July 1, 1897, the channel had been dredged 8 feet deep at mean low water, with width of 175 feet up to the old town dock, 230 feet wide at the dock, and about 100 feet wide for 200 feet farther upstream.

Detailed descriptions of the harbor and of the projects for improvement are printed in the Annual Report of the Chief of Engineers for 1897, pages 1100, 1101.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

No work was done.

PRESENT CONDITION OF IMPROVEMENT.

The dredged channel has been made 175 feet wide up to the bend at the old town dock, 230 feet wide at the bend, and about 100 feet wide for about 200 feet above the bend, the width over 100 feet being made for purposes of maintenance, in lieu of piling; the depth made has been 8 feet below mean low water.

PROPOSED OPERATIONS.

It is proposed to apply future appropriations to maintaining the channel.

Huntington Harbor is in the collection district of New York. The nearest lighthouse is on Eatons Point, at the east side of the mouth of Huntington Bay, about 4 miles distant from the harbor. The nearest works of defense are the fortifications at Willets Point, about 20 miles westward.

Money statement.

July 1, 1897, balance unexpended	$319.77
July 30, 1898, amount expended during fiscal year	319.77
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

Appropriations for improving Huntington Harbor have been made as follows:

Application.	Date.	Amount.
For a previous project:		
Dredging	June 10, 1872	$22,500
For the present project:		
Dredging	Sept. 19, 1890	10,000
Do	July 13, 1892	5,000
Do	Aug. 18, 1894	2,000
Do	June 3, 1896	5,000
Total for present project		22,000
Total for Huntington Harbor, both projects		44,500

No contract in force during the fiscal year ending June 30, 1898.

Commercial statistics for the calendar year 1897.

Articles.	Tons.	Estimated value.
Receipts:		
Coal	5,500	$22,000.00
Building material	5,317	94,000.00
Grain	767	13,609.50
General merchandise	6,500	260,000.00
Total	18,084	390,609.50
Shipments:		
Farm produce, etc	a 5,500	82,500.00

a Shipments very uncertain.

Vessels engaged in above commerce.

Class.	Number.	Estimated number of round trips.	Tonnage.	Draft.
			Tons.	*Feet.*
Steamers	3	456	125 to 240	6 to 8
Sailing vessels		109	50 to 100	7½
Barges, etc		3	200	6

The above figures show a total of 23,584 tons, which is less than the amount reported for 1896 by 49,766 tons.

No new lines of transportation are reported as established since July 1, 1897.

E 8.

IMPROVEMENT OF GLENCOVE HARBOR, NEW YORK.

This harbor is a small tidal inlet on the east side of Hempstead Harbor, Long Island, about 27 miles by water from the Battery, New York City.

PROJECT FOR IMPROVEMENT.

In 1888 a project for improvement was adopted; it was modified in 1895, and now consists in building a breakwater in Hempstead Harbor to shelter the anchorage outside Glencove Harbor, the breakwater to be about 2,000 feet long, 3 feet above high water, with top width of 5 feet. The estimated cost is $135,000.

July 1, 1897, 1,465 linear feet of the breakwater had been built.

Further details concerning the harbor and project for improvement are printed in the Annual Report of the Chief of Engineers for 1897, page 1103.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

No work of construction has been done.

A red light has been maintained upon the outer end of the uncompleted breakwater.

PRESENT CONDITION OF IMPROVEMENT.

The breakwater is now 1,465 feet long, with 3 feet top width at a level of 4 feet above mean high water. It has settled slightly in places. The work contains about 80,580 tons of riprap.

At its present length the breakwater affords a shelter to vessels waiting for tide to enter Glencove Harbor, and also to local commerce at the Glencove Dock.

PROPOSED OPERATIONS.

Future appropriations should be applied to the extension of the breakwater under the adopted project.

Glencove Harbor is in the collection district of New York. The nearest lighthouse is on Sands Point, about 4 miles west. Fort Schuyler, New York Harbor, is the nearest work of defense.

Money statement.

July 1, 1897, balance unexpended	$570.26
June 30, 1898, amount expended during fiscal year	205.20
July 1, 1898, balance unexpended	365.06
July 1, 1898, outstanding liabilities	16.00
July 1, 1898, balance available	349.06
Amount (estimated) required for completion of existing project	72,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

Appropriations for improving Glencove Harbor, New York, have been made as follows:

Application.	Date.	Amount.
Breakwater construction	Aug. 11, 1888	$20,000
Do	Sept. 19, 1890	15,000
Do	July 13, 1892	10,000
Do	Aug. 18, 1894	10,000
Do	June 3, 1896	8,000
Total		63,000

No contract for this improvement has been in force during the fiscal year ending June 30, 1898.

COMMERCIAL STATISTICS REPORTED FOR THE CALENDAR YEAR 1897.

Arrivals and departures of vessels.

[Draft, 4½ to 7½ feet; tonnage, 20 to 330 tons.]

Kind of vessels.	Number of round trips.	Aggregate tonnage of all trips.
Steamers, steam tugs, and yachts	1,855	277,405
Sailing vessels	175	29,750
Barges	624	93,600
Total	2,654	400,755

Freight received and shipped by water.

Chief articles.	Tons.	Estimated value.
Receipts:		
Coal	15,000	$60,000
Corn	50,400	720,000
Building materials, lumber, barrels, etc	150,000	105,000
Miscellaneous	185,000	1,447,000
Total		2,332,000
Shipments:		
Starch, glucose, etc	165,000	2,698,000
Miscellaneous	168,000	1,269,000
Total		3,967,000
Total receipts and shipments	733,400	6,299,000

The report for 1897 shows 626,965 tons more freight than was reported in 1896.
No new lines of transportation have been established since July 1, 1897.

E 9.

IMPROVEMENT OF FLUSHING BAY, NEW YORK.

Flushing Bay is on the north shore of Long Island, about 14 miles by water from the Battery, New York City.

PROJECT FOR IMPROVEMENT.

In 1879 a project for this improvement was adopted, which, as since modified, consists in building a dike 4,663 feet long on the west side of the channel and in making and maintaining a channel 6 feet deep at

mean low water up to the lower bridge at Flushing, at an estimated cost of $173,500.

Up to July 1, 1897, 4,663 linear feet of diking had been built; the channel had been dredged to the required depth and had been generally maintained by dredging.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

No work was done.

PRESENT CONDITION OF IMPROVEMENT.

The dike, 4,663 feet long, is in poor condition. The outer part, 1,606 feet long, which was left partly completed in 1891, has since been nearly destroyed by storms and ice. Further work upon the dike being discontinued, owing to the strong opposition of property owners along the shores of the bay (see Annual Report of the Chief of Engineers for 1892, page 723), it is not proposed to repair the structure. A small light at the outer (north) end of the dike, maintained by the Light-House Department, prevents that work in its present condition being a serious menace to local navigation.

At completion of last contract, in May, 1897, the channel up to Flushing was in good condition, with an available depth of 6 feet or over at mean low water.

PROPOSED OPERATIONS.

Future appropriations will be applied to dredging to maintain and widen the channel to Flushing.

Flushing Bay is in the collection district of New York. The nearest light-house is on North Brother Island, 3 miles to the northwest. There is a small light on the north end of the dike, in the bay, maintained by the Light-House Department. Fort Schuyler and Willets Point, about 4 miles east from the mouth of the bay, are the nearest works of defense.

Money statement.

July 1, 1897, balance unexpended	$625.24
June 30, 1898, amount expended during fiscal year	119.37
July 1, 1898, balance unexpended	505.87
Amount (estimated) required for completion of existing project	50,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

Appropriations for improving Flushing Bay, New York, have been made as follows:

Application.	Date.	Amount.
Construction of dike	Mar. 3, 1879	$20,000
Dredging	June 14, 1880	15,000
Do	Mar. 3, 1881	10,000
Do	Aug. 2, 1882	5,000
Do	July 5, 1884	10,000
Do	Aug. 5, 1886	10,000
Construction of dike and dredging	Aug. 11, 1888	15,000
Repair of dike and dredging	Sept. 19, 1890	20,000
Dredging	July 13, 1892	10,000
Do	Aug. 18, 1894	4,000
Do	June 3, 1896	4,000
Total		123,000

No contract for this improvement has been in force during the past fiscal year.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1897.

Freight received and shipped by water.

Articles.	Tons.	Estimated value.
Receipts:		
Coal	82,109	$135,872
Building materials	12,670	63,525
Paving materials a	73,566	91,691
Farm produce	20,000	57,250
Dyewoods	8,000	240,000
Miscellaneous	12,800	136,100
Total	159,145	724,438
Shipments:		
Logwood extracts	3,250	650,000
Miscellaneous	1,000	75,000
Total	4,250	725,000

a Unusual amount of paving done in 1897.

Vessels engaged in above traffic.

Class.	Number of round trips.	Tonnage.	Draft, loaded.
		Tons.	*Feet.*
Steamers	304	100 to 156	7 to 7½
Tugs	1,022		
Sail vessels	157	150 to 450	6 to 14
Barges, etc	354	100 to 700	6 to 10
Total	1,837		

The total tonnage of freights reported for 1897, 163,395 tons, is 82,575 tons greater than the amount reported for 1896.

No new lines of transportation are reported as established since July 1, 1897.

E 10.

IMPROVEMENT OF PATCHOGUE RIVER, NEW YORK.

This is a small tidal stream on the south side of Long Island, emptying into Great South Bay near its eastern end, about 55 miles east in a direct line from New York City.

PROJECT FOR IMPROVEMENT.

In 1890 a project for improving this stream was adopted which contemplated dredging a channel 60 feet wide and 6 feet deep at mean low water from Great South Bay to the head of navigation, a distance of about 5,000 feet, and protecting the entrance channel from westerly storms by a jetty 1,700 feet long, at a total estimated cost of $40,000.

Further details of the river and the projected work are printed in the Annual Report of the Chief of Engineers for 1897, page 1103.

Up to July 1, 1897, the jetty and channel had been completed. Shoals in the channel were to be removed under a contract in force.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

At the beginning of the year a contract was in force for repairing and extending the jetty and for dredging. The jetty work had been finished and the dredging nearly so.

The dredging was completed August 10, 1897. During the fiscal year 10,713 cubic yards of material were excavated, removing shoals from the previously dredged channel and making a depth of 6 feet at mean low water through its length. Dredging was done with a pumping plant, and the excavated material was carried through iron pipes on pontoons and deposited upon shore.

The total amount of work done under the contract was the delivery and placing in the jetty of 2,266.23 cubic yards of stone and the excavating of 20,811 cubic yards of sand, mud, etc.

PRESENT CONDITION OF IMPROVEMENT.

The jetty has been made 1,700 feet long.

The channel has been dredged 60 feet wide and 6 feet deep at mean low water from Great South Bay to 80 feet from the harbor lines at the head of the harbor. At the upper part for 300 feet length it was made 100 feet wide to allow vessels to turn about, and parts of the channel have been widened by private parties.

PROPOSED OPERATIONS.

The work contemplated under the adopted project has been completed. No further work is proposed.

Patchogue River is in the collection district of New York. The nearest lighthouse is at Fire Island Inlet, 14 miles southwest. The nearest work of defense is Fort Hale, New Haven Harbor, Connecticut, about 35 miles in a direct line northward.

Money statement.

July 1, 1897, balance unexpended	$5,958.47
June 30, 1898, amount expended during fiscal year	5,247.87
July 1, 1898, balance unexpended	710.60

Appropriations for improving Patchogue River, New York, have been made as follows:

Application.	Date.	Amount.
Constructing jetty and dredging	Sept. 19, 1890	$15,000
Dredging	July 13, 1892	8,000
Dredging and jetty	Aug. 18, 1894	4,000
Do	June 3, 1896	13,000
Total		40,000

CONTRACT IN FORCE DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

Contract: Dredging about 25,000 cubic yards, at 23 cents per cubic yard, prism measurement, and repairing and extending jetty, about 2,000 cubic yards of riprap, at $2.60 per cubic yard, delivered and placed. Name of contractor, Kaufman Simon, of New York City; date of contract, September 8, 1896; date of approval, September 12, 1896; date of beginning work, October 7, 1896; date of expiration, November 30, 1896; extended to April 30, 1897, and subsequently to June 20 and August 10, 1897; date of completion of contract, August 10, 1897.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1897.

Arrivals and departures of vessels.

(Draft, 2 to 9 feet; tonnage, 8 to 350 tons.)

Class.	Number of round trips.	Aggregate tonnage of all trips.
		Tons.
Steamers	1,200	70,000
Sailing vessels	7,500	90,000
Barges	4,000	150,000
Total	12,700	310,000

Vessels of 9 feet draft can not come into the river without lightering.

Freight received and shipped by water.

Articles.	Tons.	Estimated value.
Received:		
Coal	12,000	$60,000
Lumber	150,000	1,875,000
Miscellaneous	25,000	150,000
Shipped:		
Lumber	50,000	1,250,000
Fish and shellfish	5,000	150,000
Miscellaneous	8,000	120,000
Total	250,000	3,605,000

	Number.	Tons.
Vessels built during 1897	45	2 to 60
Vessels repaired during 1897	400	2 to 350

The above figures show an increase in freight over the amount reported for 1896 (143,500 tons) of 106,500 tons.

No new lines of transportation are reported as established since July 1, 1897.

E 11.

IMPROVEMENT OF BROWNS CREEK, SAYVILLE, LONG ISLAND, NEW YORK.

Browns Creek is a small stream flowing midway between the villages of Sayville and Bayport, near the south shore of Long Island, and emptying into Great South Bay about 11 miles northeast from Fire Island Inlet.

PROJECT FOR IMPROVEMENT.

In 1890 a project for improving Browns Creek was adopted, under which it was proposed to make a harbor where fishing boats can lie in rough weather, by widening and deepening the stream up to the highway bridge, making it 100 feet wide and 4 feet deep at mean low water, with 2 feet greater depth at the entrance, and to protect the entrance channel by jetties on either side, the west jetty to be 1,600 feet long and the east jetty 1,400 feet long.

July 1, 1897, the west jetty had been made 492 feet long and the east jetty 438 feet; the dredged channel had been made 1,893 feet long, 1,400 feet of which lay inside the shore line.

Further description of the locality and project is printed in the Annual Report of the Chief of Engineers for 1897, pages 1111-1112.

OPARATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

At the beginning of the year a contract for dredging was in force, under which work had been begun in September, 1896, and suspended November 2, 1896. The contractor had dredged about 5,000 cubic yards, using a dipper dredge, which he found incapable of placing the material on the bank where it would not run back into the channel.

Dredging was resumed August 23, 1897, the contractor using the pumping plant with which he had completed the dredging at Patchogue. Under an extension of contract work was continued until September 18, 1897, when the contract was completed. A detailed examination made at completion of the work showed that the total amount dredged under the contract was 24,279 cubic yards, prism measurement. This included so much of the 5,000 cubic yards dredged during the previous fiscal year as had not run back into the channel.

The channel of 100 feet width and 4 feet depth at mean low water was extended 1,100 feet, to a point about 2,500 feet above the mouth of the creek, and shoals in and near the entrance were removed.

The material was taken up with a centrifugal pump, forced through iron pipes, and deposited upon adjacent salt marshes behind low revetments of marsh sod.

PRESENT CONDITION OF IMPROVEMENT.

The west jetty is 492 feet long and the east jetty 438 feet long, both with top width of 3 feet at 1 foot above high water, and both partly covered at the shore end by accretion. They are in fair condition.

The dredged channel is 2,993 feet long, with depth of 4 feet at mean low water and width of 100 feet. About 2,500 linear feet of the channel lies inside the shore line and is frequently used for night and winter anchorage by small oyster boats. Private canals aggregating 1,525 feet in length have been dredged into the marsh on the east side of the wreck for additional anchorage and for business purposes.

PROPOSED OPERATIONS.

Future appropriations will be applied to maintaining and extending the channel and completing the jetties as projected.

Browns Creek is in the collection district of New York. The nearest light-house is at Fire Island Inlet, about 11 miles southwest. The nearest works of defense are the fortifications at Willets Point, N. Y., about 35 miles west, and Fort Hale, Connecticut, about the same distance northeastwardly.

Money statement.

July 1, 1897, balance unexpended	$3,946.22
June 30, 1898, amount expended during fiscal year	3,946.22
Amount (estimated) required for completion of existing project	21,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

Appropriations for improving Browns Creek have been made as follows:

Application.	Date.	Amount.
Jetties and dredging	Sept. 19, 1890	$12,000
Dredging	July 13, 1892	5,000
Do	Aug. 18, 1894	4,000
Do	June 3, 1896	4,000
Total		25,000

CONTRACT IN FORCE DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

Contract for dredging about 23,000 cubic yards, at 15 cents per cubic yard, prism measurement; name of contractor, Kaufman Simon, of New York City; date of contract, September 8, 1896; date of approval, September 12, 1896; date of beginning work, September 29, 1896; date of expiration, November 30, 1896, extended to April 30, 1897, and subsequently to September 18, 1897; date of completion of contract, September 18, 1897.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1897.

Freight received and shipped.

Articles.	Tons.	Estimated value.
Received:		
Coal, brick, etc	2,500	$15,800
Oysters received by water and shipped by rail	4,590	107,000
Clams	275	5,000
Shipped:		
Oysters	1,530	35,000
Clams	275	5,000
Fish	10	1,000
Total	9,180	168,800

Vessels using creek.

Class.	Number.	Round trips.	Tonnage.	Draft.
			Tons.	*Feet.*
Sailing vessels with cargoes		720	5 to 50	2 to 5
Vessels for repairs	172	172	2½ to 15	2 to 4
Vessels using creek for shelter	125	(a)	2½ to 50	2 to 5

a Not known.

The amount of freight reported above, 9,180 tons, is 77,691 tons less than reported for 1896.

No new lines of transportation are reported established since July 1, 1897.

E 12.

IMPROVEMENT OF CANARSIE BAY, NEW YORK.

Canarsie Bay is the northwest part of Jamaica Bay at and in front of Canarsie Landing.

PROJECTS FOR IMPROVEMENT.

The project for this improvement, adopted in 1880, and subsequently modified, consists in making a channel from deep water in Jamaica Bay

to Canarsie Landing, to be 6 feet deep at mean low water and from 100 to 150 feet wide, and to protect it by two parallel dikes near its outer end; also to make a channel 4 feet deep to connect Canarsie Landing with Island Channel. The estimated cost is $88,000.

Further descriptions of the locality and the project for improvement are printed in the Annual Report of the Chief of Engineers for 1897, page 1114.

Up to July 1, 1897, two pile dikes had been built and maintained on the north and south sides of the channel at the entrance into "Big Channel" of lengths, respectively, of 1,058 and 820 feet. A channel from Canarsie Landing to Big Channel had been dredged 6 feet deep and 125 to 150 feet wide; a channel southwestward to Island Channel had been made 4 feet deep and one northeastward to Gophel Channel had been made 5 feet deep.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

No work was done.

PRESENT CONDITION OF IMPROVEMENT.

The two pile dikes built at the east entrance of the main channel to Canarsie Landing are in fair condition. The north dike is 1,058 feet long, 50 feet being a return at the east end. It is mainly of creosoted timber. The channel face, for a linear distance of 20 feet near the outer end, has been broken down by the ice and the stone filling released. The south dike is 820 feet long. It is not creosoted, and many of the piles are worm-eaten.

The stone filling in both dikes has settled slightly.

The dredged channel from Canarsie Landing to "Big Channel" in Jamaica Bay has been made 125 to 150 feet wide and full 6 feet deep at mean low water, and the channel northeastwardly to Gophel Channel has been dredged 5 feet deep and about 50 feet wide. The channel southwestwardly from Canarsie Landing to Island Channel, dredged 4 feet deep, has shoaled to 3 feet depth or less.

PROPOSED OPERATIONS.

Future appropriations will be applied to keeping the dikes in repair and to maintaining and widening the dredged channels. Except for widening the dredged channels in places, the project for improvement is completed.

Canarsie Bay is in the collection district of New York. The nearest light-house is on the west end of Coney Island, about 7 miles to the southwest. The nearest work of defense is Fort Hamilton, New York Harbor.

Money statement.

July 1, 1897, balance unexpended	$529.41
July 1, 1898, balance unexpended	529.41
Amount (estimated) required for completion of existing project	23,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	10,000.00

Appropriations for improving Canarsie Bay, New York, have been made as follows:

Application.	Date.	Amount.
Constructing north dike, about 1,000 feet	June 14, 1880	$10,000
Dredging east channel, repairing north dike with crib at east end	Mar. 3, 1881 Aug. 2, 1882	5,000 3,000
Dredging east channel, extending north dike 50 feet	July 5, 1884	5,000
Dredging east channel, building south dike 820 feet	Aug. 5, 1886	10,000
Dredging east and southwest channels	Aug. 11, 1888	10,000
Dredging east channel, repairs north dike	Sept. 19, 1890	5,000
Dredging east and southwest channels	July 13, 1892	5,000
Repairs of dike, dredging	Aug. 18, 1894	2,000
Dredging	June 3, 1896	10,000
Total		65,000

No contract for this work has been in force during the fiscal year ending June 30, 1898.

COMMERCIAL STATISTICS.

A statement of commerce for the year 1897 has been asked for, but not yet received. For the year 1896 the reports showed a tonnage of 50,087 tons of freight, valued at $427,375.

E 13.

IMPROVEMENT OF BAY RIDGE CHANNEL, THE TRIANGULAR AREA BETWEEN BAY RIDGE AND RED HOOK CHANNELS, AND RED HOOK AND BUTTERMILK CHANNELS, IN THE HARBOR OF NEW YORK.

The main channel from the Narrows to the East River, New York Harbor, passes to the west and northwest of Governors Island. It has natural depths of 35 feet or over and generally an ample width. There is an eastern channel which skirts the Brooklyn water front, extending northwardly from Bay Ridge, crossing Gowanus Bay, rounding Red Hook, and thence by way of Buttermilk Channel connecting with the East River. The lower part of this channel from Bay Ridge to Erie Basin had natural depths of from 7 to 12 feet. Opposite Gowanus Bay it was separated from the main channel of the harbor by a large shoal of about 9 feet depth; the upper part had a depth of 26 feet in a channel 300 feet wide or more, but crooked, and on account of the rapid current and the large amount of traffic in and near its junction with the East River it was formerly regarded as one of the most difficult places to navigate in New York waters. The line of docks along the water front of this east channel, and especially in the upper part, from the Brooklyn Bridge to Red Hook, is one of the most important in New York Harbor.

PROJECTS FOR IMPROVEMENT.

Prior to 1896 this improvement was carried on under two separate titles: Improvement of Buttermilk Channel, New York Harbor, which included the removal of Buttermilk and Red Hook shoals, and improvement of Gowanus Bay, New York Harbor, which included Bay Ridge and Red Hook channels and the triangular area between them, and also Gowanus Creek Channel.

In 1872 a survey of Buttermilk Channel was made, and under the

river and harbor act of 1880 a project was adopted for removing the eastern part of the north shoal, called Buttermilk Shoal, to a depth of 26 feet at mean low water. The project was subsequently extended to include the removal of the entire shoal, which was accomplished July 3, 1891, at a total cost of $321,000. The amount dredged from this shoal was 1,269,484 cubic yards. In 1890 a preliminary examination of Buttermilk Channel was made, and under the river and harbor act of 1892 a project was adopted for removing the south shoal, Red Hook Shoal, to a depth of 26 feet below mean low water, estimated to require the removal of 1,484,048 cubic yards of sand and small bowlders overlying clay, at a total cost of $529,000, of which $25,000 from previous appropriations remained available. This plan did not contemplate dredging nearer to the dock line than 50 feet, thus widening the natural channel by about 1,000 feet.

Up to July 1, 1896, under this project 519,954 cubic yards had been dredged from Red Hook Shoal, cutting off the outer end of the shoal and widening the 26-foot channel by 600 feet.

A survey of Gowanus Bay was made in 1880, and under the river and harbor act of 1880 a project for improvement was adopted which, as modified by the river and harbor acts of 1890 and 1894, consisted in dredging Red Hook Channel (from Erie Basin entrance to the foot of Henry street) to a width of 400 feet and depth of 26 feet at mean low water; Gowanus Creek Channel (from Henry street to Percival street) to a width of 250 feet and depth of 21 feet; Gowanus Canal (from Percival street to the Hamilton Avenue Bridge) to a width of 200 feet and depth of 18 feet; Bay Ridge Channel (from Henry street and Twenty-eighth street to the 26-foot curve opposite Bay Ridge) to a width of 800 feet and depth of 26 feet, and the triangular area between Bay Ridge and Red Hook channels to a maximum width of 900 feet and depth of 26 feet. The total estimated cost of this work was $1,124,400. Under this project, up to July 1, 1896, Red Hook Channel had been made 200 feet wide and 26 feet deep, an additional 150 feet of width being made 21 feet deep; Gowanus Creek had been made 21 feet deep between the harbor lines; Gowanus Canal had been made 12 feet deep; Bay Ridge Channel had been made 175 to 200 feet wide and 26 feet deep, and an additional width of 175 to 200 feet had been made 21 feet deep. No work had been done upon the triangular area.

By the terms of the river and harbor act of 1896 the Bay Ridge and Red Hook channels, the triangular area between them, and the Buttermilk Channel were consolidated into one improvement, together with a small improvement of Gowanus Canal, and the project for this work now consists in dredging channels of 26 feet depth at mean low water, with widths as follows: For Bay Ridge Channel, 800 feet; for the triangular area between Bay Ridge and Red Hook channels, maximum width 900 feet; for the Red Hook Channel, 400 feet; for Buttermilk Channel, at Red Hook Shoal, 1,000 feet, and for dredging Gowanus Canal from Percival street to Hamilton Avenue Bridge to the extent of $5,000, at a total estimated cost of $837,000.

Under this consolidated project, up to July 1, 1897, 872,617 cubic yards of material had been dredged, widening Bay Ridge Channel below Forty-third street 625 feet, making it 800 feet wide, and above Forty-third street widening it about 80 feet and making it 270 feet wide, and the projected work in Gowanus Canal had been completed.

Harbor lines in Gowanus Bay and Buttermilk Channel were established by the Secretary of War March 4, 1890. These harbor lines in the Gowanus Creek Channel were slightly modified by act of Congress passed June 3, 1896.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

At the beginning of the year dredging was in progress under a continuing contract entered into with the W. H. Beard Dredging Company, of New York City, under date of October 6, 1896, approved by the Chief of Engineers October 15, 1896.

Work has been continued without intermission and during the year 1,499,462 cubic yards of material have been dredged, as follows:

	Cubic yards.
From Bay Ridge Channel	574,346
From the triangular area	559,799
From Red Hook Channel	365,317
Total	1,499,462

Bay Ridge Channel has been made the full depth and width (26 feet and 800 feet) from its lower end to its junction with Red Hook Channel; the triangular area has been made the full depth and width (26 and 900 feet) over its whole area between Bay Ridge and Red Hook channels; Red Hook Channel has been made the full depth and full or part width (26 and 400 feet) in several sections south and east of Erie Basin Entrance, where work is in progress.

The number of dredges employed on this work during the year has ranged from two to six.

PRESENT CONDITION OF IMPROVEMENT.

Bay Ridge Channel has been dredged 800 feet wide and 26 feet deep at mean low water throughout its entire length.

The triangular area between Bay Ridge and Red Hook channels has been dredged 26 feet over the whole area.

Red Hook Channel has been dredged 26 feet deep, with widths of 400 feet or less where work is now in progress.

All of these channels have shoaled in places from 1 to 2 feet.

PROPOSED OPERATIONS.

Under the contract now in force, with the available funds and with such appropriations as may be made, it is proposed to complete the dredging contemplated by the project and to remove such shoals as have formed or may form in these channels.

These channels are in the collection district of New York, of which New York City is the port of entry. The nearest light-house is the statue of Liberty Enlightening the World, on Bedloes Island, about 1½ miles west. The nearest work of defense is Fort Columbus, Governors Island, New York.

Money statements.

FOR BAY RIDGE, RED HOOK, AND BUTTERMILK CHANNELS.

July 1, 1897, balance unexpended		$455,560.31
Amount appropriated by sundry civil act approved July 1, 1898		130,000.00
		585,560.31
June 30, 1898, amount expended during fiscal year		193,770.74
July 1, 1898, balance unexpended		391,789.57
July 1, 1898, outstanding liabilities	$59,847.39	
July 1, 1898, amount covered by uncompleted contracts	172,030.68	
		231,878.07
July 1, 1898, balance available		159,911.50

IMPROVING CHANNEL IN GOWANUS BAY, NEW YORK.

July 1, 1897, balance unexpended	$1,059.00
June 30, 1898, amount expended during fiscal year	1,059.00

IMPROVING BUTTERMILK CHANNEL, NEW YORK.

July 1, 1897, balance unexpended	$2,387.32
July 1, 1898, balance unexpended	2,387.32

Appropriations for improving Bay Ridge and Red Hook channels, and the triangular area between them, and Buttermilk Channel, New York Harbor, have been made as follows:

For previous projects.

Application.	Date.	Amount.	
		Buttermilk Channel, including Buttermilk and Red Hook shoals.	Bay Ridge, Red Hook, and Gowanus Creek channels.
Dredging	June 14, 1880	$60,000	
Do	Mar. 4, 1881	60,000	$40,000
Do	Aug. 2, 1882	60,000	20,000
Do	July 5, 1884	10,000	5,000
Do	Aug. 5, 1886	56,250	7,500
Do	Aug. 11, 1888	100,000	60,000
Do	Sept. 19, 1890		160,000
Do	July 13, 1892	100,000	198,600
Do	Aug. 18, 1894	50,000	150,000
Total		496,250	641,100
Received from other sources		100	
Total		496,350	641,100

Total for previous projects, including dredging in Gowanus Canal, $1,137,450.

For present projects.

Application.	Date.	Amount.
Dredging	June 3, 1896	$200,000
Do	June 4, 1897	350,000
Do	July 1, 1898	130,000
Total		680,000

CONTRACT IN FORCE DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

Contract for dredging about 3,000,000 cubic yards from Bay Ridge Channel, the triangular area between Bay Ridge and Red Hook channels, from Red Hook Channel and Gowanus Canal, at 14 cents per cubic yard, measured in scows, and about 1,000,000 cubic yards from Red Hook Shoal, Buttermilk Channel, at 21 cents per cubic yard, measured in scows. Name of contractor, The W. H. Beard Dredging Co., New York City; date of contract, October 6, 1896; date of approval, October 15, 1896; date of beginning work, October 20, 1896; expiration of contract, indefinite; the contract provides for completion of the project whenever appropriations are made for the purpose.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1897.

Freight received and shipped by water.

	Amounts.	Estimated value.
	Tons.	
Bay Ridge Channel (Sixty-ninth to Twenty-eighth street):		
Receipts	608, 960	$8, 829, 234
Shipments	135, 523	6, 177, 427
Red Hook Channel (Henry street to Red Hook):		
Receipts	4, 098	82, 800
Buttermilk Channel (Red Hook to Atlantic avenue):		
Receipts	5, 369, 900	237, 193, 500
Shipments	6, 234, 600	317, 594, 000
Total	12, 353, 171	569, 836, 961

Vessels, not including tugs or ferry-boats.

	Number.	Draft.	Tonnage.
		Feet.	*Tons.*
Bay Ridge Channel (Sixty-ninth to Twenty-eighth street):			
Steam	921	6 to 22	50 to 1, 600
Sail	1, 094	5 to 20	35 to 1, 600
Barges	2, 409	6 to 18	75 to 600
Red Hook Channel (Henry street to Red Hook):			
Sail	12	.....	.....
Buttermilk Channel (Red Hook to Atlantic avenue):			
Steam	1, 435	18 to 29	1, 000 to 6, 800
Sail	944	12 to 26	500 to 3, 000
Barges	33, 646	.....	.....
Total	40, 461	.....	.....

The above includes only freights received and shipped at the docks. The coal business of Red Hook Channel in 1896 is reported in 1897 as done in Gowanus Creek, just above Red Hook Channel. The reports for Buttermilk Channel for 1897 as received gave amounts from Red Hook to the Brooklyn Bridge; they are reduced to a north limit at Atlantic avenue, to compare with previous reports.

In addition to the above, 2,731,433 tons of freight are reported as passing through these channels into Gowanus Creek and Gowanus Canal, carried in 14,825 vessels of 4 to 23 feet draft. Additional freights pass through these channels, the amounts of which there is no means of estimating.

E 14.

IMPROVEMENT OF GOWANUS CREEK CHANNEL, NEW YORK.

Gowanus Creek was originally a tidal inlet in the southern part of the city of Brooklyn, emptying into Gowanus Bay. This creek has been improved by the United States as part of the improvement of Gowanus Bay, and for the purpose of the improvement the Gowanus Creek Channel has been defined as extending from the junction of the Bay Ridge and Red Hook channels, opposite Henry street, Brooklyn, and Twenty-eighth street, South Brooklyn, eastwardly to the foot of Percival street, that part of the creek east of Percival street being called Gowanus Canal.

In 1880, before improvement by the United States, Gowanus Creek Channel had an available depth of about 11 feet at mean low water

PROJECTS FOR IMPROVEMENT.

A survey of Gowanus Creek and Bay was made in 1880, and in 1881 a project for improvement was adopted providing for a channel in Gowanus

Creek 18 feet deep at mean low water and 200 feet wide, which, with the Gowanus Bay channels, was estimated to cost $182,500. After the depth had been made, under the terms of the river and harbor act of 1888, the project was extended to provide for a depth of 21 feet at mean low water. This depth was made between the harbor lines on either side of the creek, under the river and harbor act of 1892, and the project was completed. At the time of completion of the project $491,100 had been appropriated for and expended upon the several channels in Gowanus Bay. It is estimated that about $75,000 of this sum was applied to the Gowanus Creek Channel.

Under the river and harbor act of 1896, appropriating $25,000 for improving Gowanus Creek Channel, New York, by deepening the same to 26 feet at mean low water from the foot of Percival street to its junction with the Red Hook Channel, a project was adopted for making Gowanus Creek Channel 26 feet deep at mean low water, at an estimated cost of $70,000.

Harbor lines for part of New York Harbor, including the Gowanus Creek Channel, were established by the Secretary of War March 4, 1890.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

At the beginning of the year dredging was in progress under a contract for removal of about 91,600 cubic yards of material, entered into March 20, 1897, with Henry S. Beard, of New York City. Dredging was continued until July 17, 1897, when the contract was completed; the amount of material dredged during the fiscal year was 16,073 cubic yards.

The total amount dredged under the contract was 91,490 cubic yards, and the channel of Gowanus Creek throughout its entire length from Twenty-eighth street to Percival street, a distance of 3,000 feet, was made 125 feet wide and 26 feet deep at mean low water where the depths had been 20 to 22 feet.

PRESENT CONDITION OF IMPROVEMENT.

Under previous projects Gowanus Creek was dredged to 21 feet depth at mean low water between the harbor lines on either side. Under the present project the channel has been deepened to 26 feet for a width of 125 feet.

PROPOSED OPERATIONS.

Future appropriations will be applied to widening the channel, as proposed in the project.

Gowanus Creek is in the collection district of New York. The nearest light-house is the statue of Liberty Enlightening the World, on Bedloes Island, New York Harbor. The nearest work of defense is Fort Columbus, Governors Island, New York.

Money statement.

July 1, 1897, balance unexpended	$13,870.50
June 30, 1898, amount expended during fiscal year	12,829.31
July 1, 1898, balance unexpended	1,041.19
Amount (estimated) required for completion of existing project	45,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

Appropriations for Gowanus Creek Channel, New York, have been made as follows:

Application.	Date.	Amount.
For previous projects: Parts of the appropriations for Gowanus Bay channels, applied to Gowanus Creek, estimated to amount to about $75,000; dredging to 21 feet depth.	Mar. 3, 1881, to July 13, 1892.	$75,000
For the present project: Dredging 26 feet deep	June 3, 1896	25,000
Total		100,000

CONTRACT IN FORCE DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

Contract for dredging: About 91,600 cubic yards, at 24 cents per cubic yard for sand, etc., and $12 per cubic yard for bowlders of one-half cubic yard or over; name of contractor, Henry S. Beard, of New York City; date of contract, March 20, 1897; date of approval, March 25, 1897; date of beginning work, April 5, 1897; date of expiration, September 30, 1897; contract completed, July 17, 1897.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1897.

Cargoes.

	Tons.	Estimated value.
Receipts: Coal, lumber, steel, and general merchandise	156,964	$1,394,875
Shipments: Miscellaneous	58,388	1,236,877
Total	215,352	2,631,752

Vessels engaged in above commerce.

	Number.	Draft, loaded.	Tonnage.
		Feet.	*Tons.*
Steamers	758	6 to 18	75 to 1,800
Sail vessels	950	4 to 23	100 to 3,128
Barges, etc	3,387	4 to 13	50 to 600
Total	5,095		

The above refers to freight unloaded along Gowanus Creek, and is 5,396 tons less than reported for 1896.

In addition to this there was carried through the creek, to or from Gowanus Canal, 2,083,680 tons of freight, in 7,405 vessels of 4 to 12 feet draft. Also 490,789 tons of coal and lumber was taken into Columbia Basin, just inside the entrance of Gowanus Creek, there to be assembled into tows and dispatched to destinations; this was reported as in Red Hook Channel in 1896.

No new lines of transportation are reported as established since July 1, 1897.

E 15.

IMPROVEMENT OF NEWTOWN CREEK, NEW YORK.

Newtown Creek is a tidal stream about 4 miles long, extending northerly and westerly through Brooklyn, N. Y., and emptying in the East River opposite Thirty-fourth street.

The mean rise of tide in the creek is about 4½ feet.

PROJECTS FOR IMPROVEMENT.

The first project for improvement, adopted in 1881, and subsequently extended, proposed a channel of varying widths and depths from the mouth of the creek up to the Metropolitan Avenue crossings in both the east and west branches.

By the terms of the river and harbor act of 1896 this project was modified so as to provide for a channel uniformly 125 feet wide and 18 feet deep at mean low water up to the Metropolitan Avenue bridges, at an estimated cost of $450,000.

Up to July 1, 1897, this channel had been dredged to a point 2,735 feet above the Greenpoint Avenue Bridge, being about 2 miles above the mouth of the creek, except in and close to the draws of the Vernon Avenue and Greenpoint Avenue bridges, where work was delayed to admit of rebuilding or protecting the bridge piers.

Further details of previous projects are printed in the Annual Report of the Chief of Engineers for 1896, pages 760–761.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

At the beginning of the year dredging was in progress under a contract for the completion of the project entered into with John H. Fenner, of Jersey City, N. J., October 20, 1896.

Dredging was continued during the entire fiscal year, removing 423,587 cubic yards of sand, etc., and 95.54 cubic yards of bowlders, each of one-half cubic yard volume or over. The channel of 125 feet width and 18 feet depth was extended to the junction of the two branches of the creek a further distance of 5,450 feet, and thence up the west branch for 900 feet, and up the east branch for 1,000 feet. The channel through the north draw of Greenpoint Avenue Bridge was also made 18 feet deep; dredging in the immediate vicinity of the draw of Grand Street Bridge, east branch, was deferred to allow the city time to strengthen the bridge piers. Dredging is still in progress.

PRESENT CONDITION OF IMPROVEMENT.

The channel has been made 18 feet deep at mean low water and 125 feet wide from the mouth of the creek to and above Grand Street Bridge over the east branch, and to a point 900 feet up the west branch, except in and close to the draw of the Vernon Avenue, Greenpoint Avenue, and Grand Street bridges, where dredging was postponed to admit of rebuilding or protecting the bridge piers.

In many places where the banks of the dredged channel are high the sides of the channel have shoaled from 1 to 3 feet. The contract in force provides for removal of these shoals.

PROPOSED OPERATIONS.

Under the contract now in force, and with the funds already appropriated, the project for a channel 125 feet wide and 18 feet deep at mean low water will be completed.

Newtown Creek is in the collection district of New York, of which New York City is the port of entry. The nearest light-house is on Blackwells Island, New York Harbor. The nearest work of defense is Fort Columbus, Governors Island, New York Harbor.

Money statement.

July 1, 1897, balance unexpended		$192,046.33
June 30, 1898, amount expended during fiscal year		69,712.24
July 1, 1898, balance unexpended		122,334.09
July 1, 1898, outstanding liabilities	$18,079.94	
July 1, 1898, amount covered by uncompleted contracts	93,164.87	
		111,244.81
July 1, 1898, balance available		11,089.28

Appropriations for Newtown Creek have been made as follows:

Application.	Date.	Amount.
Dredging below Vernon avenue	June 14, 1880	$10,000
Do	Aug. 2, 1882	15,000
Dredging entrance to Metropolitan avenue	July 5, 1884	20,000
Do	Aug. 5, 1886	37,500
Do	Aug. 11, 1888	25,000
Dredging entrance to Metropolitan avenue and English Kills	Sept. 19, 1890	35,000
Dredging entrance to Metropolitan avenue	July 13, 1892	35,000
Do	Aug. 18, 1894	20,000
Dredging	June 3, 1896	30,000
Dredging (not yet expended)	June 4, 1897	183,000
Total		410,500

CONTRACT IN FORCE DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

Dredging about 965,000 cubic yards of material, at 17⅞ cents per cubic yard, and removing bowlders of one-half cubic yard volume or over, at $8 per cubic yard. Name of contractor, John H. Fenner, of Jersey City, N. J.; date of contract, October 20, 1896; date of approval, October 21, 1896; date of beginning work, November 12, 1896; expiration of contract, October 31, 1898.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1897.

Freights received and shipped by water.

	Tons.	Estimated value.
Received	2,402,551	$29,596,218
Shipped	825,993	21,850,713
Total	3,228,544	51,446,931

This freight consists of coal, lumber, building materials, petroleum products, chemicals, and miscellaneous goods.

In addition, there were about 420,000 tons of cellar excavations and street cleanings received for filling low lands.

Vessels engaged in above commerce.

Kind of vessels.	Number.	Draft, loaded.	Tonnage.
		Feet.	*Tons.*
Steamers, tugs not included	1,068	6 to 19	120 to 2,250
Sailing vessels	1,768	6 to 19	50 to 3,200
Barges, etc	12,628	6 to 12	100 to 600
Total	15,464		

The above record of freights received and shipped shows an increase of 488,062 tons over the figures reported for 1896.

No new lines of transportation are reported established since July 1, 1897.

E 16.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

1. Wreck in Newtown Creek, New York, about 450 feet above Meeker Avenue Bridge.—This wreck had been lying near the channel of Newtown Creek for several years, and only became an immediate source of danger to navigation when the channel was being widened and deepened under authority of the river and harbor act of June 3, 1896.

An allotment of $200 was made for removing the wreck; proposals were invited and three bids were received, all of which were considered too high and were rejected. A subsequent offer of the Baxter Wrecking Company to remove the wreck for the sum of $200 was accepted.

August 27, 1897, the wreck was lifted bodily and was floated away to the contractors' wrecking yards in Weehawken, N. J. There was nothing of value on the wreck.

Abstract of proposals for removing wreck in Newtown Creek, New York, received by Maj. H. M. Adams, Corps of Engineers, New York City, August 23, 1897.

Name and address of bidders.	Price.
Merritt & Chapman Derrick and Wrecking Co., 27 William street, New York City	$573.00
John H. Fenner, Fuller Building, Jersey City, N. J	250.00
Baxter Wrecking Co., 308 West street, New York City	269.00

All bids rejected as excessively high.

E 17.

MODIFICATION OF HARBOR LINES ON THE EAST SIDE OF EAST RIVER AT LONG ISLAND CITY FROM THE CANAL OF THE DEVOE MANUFACTURING COMPANY TO NEWTOWN CREEK.

NEW YORK SUGAR REFINING COMPANY,
Long Island City, December 13, 1897.

DEAR SIR: As owners of the property fronting on the East River in Long Island City, State of New York, we respectfully ask for an amendment to the pier line on map inclosed herewith, dated January, 1890, entitled "Pierhead and bulkhead line of the easterly shore of the East River, New York," as we are now about completing our factories, marked in red on the map inclosed.

For our business we require at least 100 feet extension from the present established line, as a great deal of our business is done by water, and our material comes in large vessels from foreign countries.

Yours, respectfully,

THE NEW YORK SUGAR REFINING COMPANY.
CLAUS DAREHERE, *President.*

Hon. R. A. ALGER,
Secretary of War.

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
December 18, 1897.

Respectfully referred to Col. Henry M. Robert, Corps of Engineers, for consideration and report by the New York Harbor Line Board.

By command of Brig. Gen. Wilson:

A. MACKENZIE,
Lieut. Col., Corps of Engineers.

[Third indorsement.]

NEW YORK HARBOR LINE BOARD,
New York City, January 31, 1898.

Respectfully returned to the Chief of Engineers, inviting attention to the report of the New York Harbor Line Board of January 28, 1898.

HENRY M. ROBERT,
Colonel, Corps of Engineers, President of the Board.

REPORT OF THE NEW YORK HARBOR LINE BOARD.

HARBOR LINE BOARD,
New York City, January 28, 1898.

GENERAL: In compliance with your indorsements of December 18, 1897, and December 30, 1897, the New York Harbor Line Board has considered the applications of the New York Sugar Refining Company for an extension of the established pierhead lines on the east side of the East River in front of that company's property at Long Island City, and has the honor to submit the following report thereon:

Notice was given by advertisements in newspapers, and by correspondence, that a public hearing in the matter would be held at the Army Building on January 24, at which all persons concerned were invited to submit their views.

The Board, on January 4, made personal examination of the water front between Ravenswood and Newtown Creek, and finding that considerable changes had been made in riparian constructions since the date of the latest chart, had the locality in question resurveyed.

At the hearing of January 24, it was shown that other interests than the New York Sugar Refining Company had applications to make, and certain objectors desired further time for consideration of the subject.

An adjourned hearing was therefore notified for and held on January 28, at which the matter was concluded.

The stenographic records of both hearings, and the papers and other documents relative to the case are herewith submitted.

After full consideration, the Board is of opinion that the pierhead line may be extended, as indicated in the following detailed description, and shown on the accompanying tracing,* to the advantage of commerce and without material injury to the navigation, and therefore recommends that the harbor lines be approved as thus modified.

The present harbor line in the locality in question is a combined pier and bulkhead line. The recommended extension of the pierhead line separates the two and leaves the bulkhead line unchanged.

DESCRIPTION.

Beginning at a point in the pier and bulkhead line approved by the Secretary of War February 8, 1890, on the southerly side of canal of the Devoe Manufacturing

* Not printed.

Company, 665 feet westerly from the westerly side of West avenue; thence southerly in a straight line to a point in the westerly prolongation of the southerly side of Sixth street, 1,119 feet from the westerly side of West avenue; thence southerly in a straight line to a point in the westerly prolongation of the southerly side of Flushing street, 928 feet from the westerly side of Front street; thence southerly in a straight line to a point in a line parallel to Pier street, and 280 feet southerly of the southerly side thereof, measured at right angles thereto, 723 feet westerly from the westerly side of River street prolonged; thence southerly in a straight line to a point in a line parallel to Pier street, and 859 feet southerly of the southerly side thereof, measured at right angles thereto, 576 feet westerly from the westerly side of River street prolonged; thence easterly in a straight line to a point in a line parallel to Pier street, and 795 feet southerly of the southerly side thereof, measured at right angles thereto, 499 feet westerly of the westerly side of River street prolonged, said point being in the pier and bulkhead line approved by the Secretary of War February 8, 1890.

Respectfully submitted.

HENRY M. ROBERT,
Colonel, Corps of Engineers.
G. L. GILLESPIE,
Colonel, Corps of Engineers.
WILLIAM LUDLOW,
Lieut. Col., Corps of Engineers.
H. M. ADAMS,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
February 4, 1898.

Respectfully submitted to the Secretary of War.

The New York Sugar Refining Company having made application for an extension of the established pierhead line on the east side of the East River, in front of the company's property, the subject was referred for consideration and report to the New York Harbor Line Board.

The Board, after notice by advertisements in newspapers, held public hearings in the matter, at which all parties interested were invited to submit their views. It developed at the hearings that other owners of water-front property desired extensions of the established line, and the Board gave consideration to all applications made.

After careful consideration, the Board recommends a modification of the existing line, as shown on the accompanying map and described in the within report. The existing harbor line is a combined pierhead and bulkhead line and the modification recommended by the Board separates the two, extending the pierhead line and leaving the bulkhead line unchanged.

I recommend that the modification adopted by the Board be approved, and that the Secretary place his approval both upon this report and upon the map which has been prepared for his signature.

JOHN M. WILSON,
Brig. Gen., Chief of Engineers,
U. S. Army.

[Second indorsement.]

WAR DEPARTMENT, *February 18, 1898.*

Approved as recommended by the Chief of Engineers.

G. D. MEIKLEJOHN,
Acting Secretary of War.

E 18.

MODIFICATION OF HARBOR LINES ON THE BROOKLYN SIDE OF EAST RIVER, NEW YORK, BETWEEN HAMILTON AVENUE AND THE NEW YORK AND BROOKLYN BRIDGE.

BROOKLYN WHARF AND WAREHOUSE COMPANY,
New York, August 17, 1897.

DEAR SIR: We inclose herewith a petition by this company and the Union Ferry Company for an extension of the pier line on the East River between the Fulton and Hamilton ferries; also supplementary petitions by the owners or agents of steamship lines and the owners and agents of tugboats; also two maps showing the present length of the piers and proposed line, and the relative situation and character of the property back of the piers.

We respectfully ask that you give this matter early consideration.

Yours, truly,

THOS. A. MCINTYRE, *President.*

HON. RUSSELL A. ALGER,
Secretary of War.

[Second indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
August 20, 1897.

Respectfully referred to Col. Henry M. Robert, Corps of Engineers, for consideration and report by the New York Harbor Line Board.

To be returned.

A. MACKENZIE,
Acting Chief of Engineers.

[Third indorsement.]

NEW YORK HARBOR LINE BOARD,
New York, November 5, 1897.

Respectfully returned to the Chief of Engineers, inviting attention to the report of the Board dated November 4, 1897.

HENRY M. ROBERT,
Colonel, Corps of Engineers, President of the Board.

REPORT OF THE NEW YORK HARBOR LINE BOARD.

HARBOR LINE BOARD,
New York City, November 4, 1897.

GENERAL: In compliance with your indorsement of August 20, 1897, the New York Harbor Line Board has considered the petitions of the Brooklyn Wharf and Warehouse Company and others, dated August 17, 1897, for an extension of the established pierhead line on the Brooklyn side of the East River, New York, between Fulton and Hamilton ferries, and has the honor to submit the following report thereon:

A public hearing in this matter was given by the Board on September 28, 1897. This hearing had been advertised in the public press, and other means taken to bring it to the notice of all interested parties. As a result the hearing was largely attended, and a stenographic report of the same is herewith inclosed, marked Appendix A.*

* Not printed.

On October 12, 1897, a communication of the same date was received from Mr. Thomas A. McIntyre, president of the Brooklyn Wharf and Warehouse Company, in which the company submitted an application for an extension materially modified from that which the company submitted to the Secretary of War on August 17, 1897. A copy of this modified request is herewith inclosed, marked Appendix B.*

There are also inclosed herewith, marked, respectively, Appendix C* and Appendix D,* a letter on this subject addressed by the Department of Docks of New York City to Lieut. Col. William Ludlow, Corps of Engineers, dated October 15, 1897, and one from the same department, dated October 19, 1897, addressed to Col. Henry M. Robert, Corps of Engineers.

Subsequently to the presentation of the application of October 13, 1897, the Board granted an interview to Mr. McIntyre, who was accompanied by the counsel of the company, Mr. Fred. L. Middlebrook, and by the manager of the company, Mr. J. B. Martin. At this interview Mr. McIntyre presented, orally, a request for a still further modification of his two former applications, and the Board, after deliberation, has decided to recommend that the existing pierhead line in the locality in question be modified so as to conform to the suggestion submitted to the Board by Mr. McIntyre in the last interview above mentioned. This modification is fully set forth in the following description of the pierhead line which the Board, after a careful personal investigation, now recommends for adoption, viz:

Beginning at a point at the foot of Hamilton avenue, Brooklyn, in the pierhead line approved by the Secretary of War March 4, 1890, in the westerly prolongation of a line perpendicular to the north side of pier north 279 feet therefrom and 23.5 feet west from the west side of Hamilton avenue; thence in a straight line to a point in the westerly prolongation of a line at the north side of Pier No. 26 and perpendicular to the westerly side of Columbia street 1,421 feet therefrom and 47.5 feet southerly from the southerly side of Congress street; thence in a straight line to a point in the westerly prolongation of a line at the north side of Pier No. 8 and perpendicular to the westerly side of Furman street 833 feet therefrom and 1,179 feet southerly of the southerly side of Fulton street; thence in a straight line to a point in the westerly prolongation of a line at the north side of Pier No. 4 perpendicular to the westerly side of Furman street 569 feet therefrom and 270 feet southerly from the southerly side of Fulton street; thence in a straight line to a point in the westerly prolongation of a line perpendicular to the westerly side of Furman street and 338 feet therefrom; thence in a straight line to a point in the pierhead line approved by the Secretary of War March 4, 1890, in the westerly prolongation of the southwest face of the tower of the New York and Brooklyn Bridge on the Brooklyn side 20 feet distant from the northwest face of said tower.

Accompanying this report is a tracing* showing the proposed modified line.

Respectfully submitted.

HENRY M. ROBERT,
Colonel, Corps of Engineers.
G. L. GILLESPIE,
Colonel, Corps of Engineers.
WILLIAM LUDLOW,
Lieut. Col., Corps of Engineers.
C. W. RAYMOND,
Major, Corps of Engineers.
H. M. ADAMS,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

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*Not printed.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
November 9, 1897.

Respectfully submitted to the Secretary of War.

Application having been made by the Brooklyn Wharf and Warehouse Company and others for an extension of the established pierhead line on the Brooklyn side of the East River, between Fulton and Hamilton ferries, the subject has been considered by the New York Harbor Line Board, and the interested parties have been accorded a public hearing after advertisement of the same in the public press.

As a result of its deliberations the Board recommends the modification of the pierhead line as described in the within report and indicated in red on the accompanying drawing.

I concur in the views of the Board, and recommend that the modified line be approved and that the Secretary place his approval both upon the report and the drawing.

JOHN M. WILSON,
Brig. Gen., Chief of Engineers,
U. S. Army.

[Second indorsement.]

WAR DEPARTMENT, *November 17, 1897.*

Approved as recommended by the Chief of Engineers.

R. A. ALGER,
Secretary of War.

APPENDIX F.

IMPROVEMENT OF HARLEM AND EAST RIVERS AND OF NEW YORK HARBOR, NEW YORK.

REPORT FOR THE FISCAL YEAR ENDING JUNE 30, 1898, WITH OTHER DOCUMENTS RELATING TO THE WORKS. OFFICERS IN CHARGE, BRIG. GEN. WILLIAM LUDLOW (NOW MAJ. GEN.), U. S. VOLUNTEERS, LIEUTENANT-COLONEL, CORPS OF ENGINEERS, AND MAJ. H. M. ADAMS, CORPS OF ENGINEERS.

IMPROVEMENTS.

1. Harlem River, New York.
2. East River and Hell Gate, New York.
3. New York Harbor, New York.
4. Removing sunken vessels or craft obstructing or endangering navigation.

(For letter of transmittal see Appendix E.)

F 1.

IMPROVEMENT OF HARLEM RIVER, NEW YORK.

Harlem River and Spuyten Duyvil Creek are two tidal inlets, from the East River and Hudson River respectively, which joined at Kings Bridge and separated Manhattan Island from the mainland to the north.

The Harlem River had a natural fair channel 10 feet deep at low water from the East River, near Hell Gate, to Morris Dock, a distance of 5 miles, except at High Bridge, where the depth was reduced to 6 feet by the débris of stone, etc., carried into the river during the construction of the bridge; for a mile farther, to Fordham Landing, it had a crooked channel of 7 feet depth; above Fordham Landing, to Kings Bridge, a farther distance of about a mile, the channel was too narrow and crooked to be used by any but the smallest class of boats. From Kings Bridge to the Hudson River, a distance of 1¾ miles, Spuyten Duyvil Creek had a natural available depth of about 4 feet at low water. At Kings Bridge the channel between the two inlets was very narrow and nearly cut off by a ledge of rocks, awash at low tide.

The mean rise of tide in the Harlem River was from 5.5 to 6 feet; in Spuyten Duyvil Creek it was 3.8 feet. Mean high-water level in the Hudson River at Spuyten Duyvil Creek was nearly a foot lower and one hour and forty minutes earlier than in the Harlem River.

PROJECT FOR IMPROVEMENT.

This project, adopted in 1875 and subsequently modified, consists in making a navigable channel between the East and Hudson rivers, by way of Harlem River and Spuyten Duyvil Creek, cutting off the sharp bend at Kings Bridge by a canal through Dyckman Meadow, the width of channel to be 350 to 400 feet, and the depth at mean low water to be 15 feet, except through Dyckman Meadow rock cut, where it was to be 18 feet, the work to be done by rock removal and dredging, and the sides of channel to be protected in places by diking or revetment. The estimated cost is $2,700,000.

Up to the beginning of the last fiscal year a free channel of 12 to 15 feet depth at mean low water had been made through the entire course between East and Hudson rivers, with 18 feet depth at the Dyckman Meadow rock cut. At this cut the width had been made 350 feet; south and east of it, to the East River, the width was 150 feet or over, and west of it, to the Hudson River, the width was 200 feet or over.

Further detailed descriptions of the locality and projects are printed in the Annual Report of the Chief of Engineers for 1875, Part II, page 224, and for 1887, Part I, page 665.

Harbor lines for Harlem River and Spuyten Duyvil Creek were established by the Secretary of War October 18, 1890, and modified October 2, 1893, and again January 8, 1897.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

At the beginning of the year dredging was in progress under a contract with Rittenhouse R. Moore, dated September 26, 1896, and expiring June 30, 1898; the contract provided for dredging about 413,000 cubic yards of material from the Harlem River and Spuyten Duyvil Creek, and for building about 800 linear feet of crib-work revetment to protect the west side of the channel where it cuts through the point of meadow south of Fordham Bridge. Under this contract 92,102 cubic yards had been dredged.

Dredging was continued until February 9, 1898, when that part of the contract was completed. During the fiscal year 320,688 cubic yards were dredged. The channel between the Hudson River and the west end of the rock cut was widened 30 to 60 feet at the most contracted places, and is now 200 to 280 feet wide. From the rock cut eastward to Macombs Dam Bridge the channel was widened from 30 to 100 feet in places and has a present width of 180 to 300 feet.

The total amount dredged under the contract was 412,790 cubic yards.

Construction of revetment under the same contract was begun November 6, 1897, and completed in February, 1898. The revetment consists of a crib substructure, built, loaded with stone, and sunk in place, covered with a superstructure also filled with stone. The revetment is built to a height of 9 feet above low water, being an average height for the structure of 26 feet; it is 13 feet wide on top and 24 feet wide on the bottom, and the total length built is 741 feet.

During the year the United States drill scow *Hudson* was employed from July 1, 1897, to May 23, 1898, in removing shoal ledges and bowlders uncovered by previous dredging near the entrance to Mott Haven Canal, at the cross-over channel near Morris Dock, and at and above Macombs Dam Bridge; at the latter place the remains of foundations of old bridge piers were taken up. The amount of rock removed was 1,602 tons, and at all these places the large rocks were completely

removed to a depth of 12 feet at mean low water, except in front of Mott Haven Canal, where the rock was removed to a depth of 15 feet. Small material which could not be chained and lifted with the drill scow was left for future dredging, this material being all over 12 feet deep.

October 13, 1897, proposals were received for construction of about 40 linear feet of stone retaining wall on the north side of Dyckman Meadow Cut, west of Broadway. A contract was entered into under date of November 1, 1897, with Ulrich Maurer Sons, at rates of $10.50 per cubic yard of concrete masonry in the substructure and $7.50 per cubic yard of rubble masonry in the superstructure. Work was begun in November, 1897, and completed in the following month. The retaining wall was made 41 feet long and built to 10 feet above mean low water; it contains 244 cubic yards of concrete and 103½ cubic yards of rubble masonry.

PRESENT CONDITION OF IMPROVEMENT.

From the Hudson River to Macombs Dam Bridge the improved channel is now 12 feet deep and over at mean low water and from 180 to 300 feet wide; through the rock cut the depth is 18 feet and width 350 feet. From Macombs Dam Bridge south to Wards Island, East River, the available channel is 15 feet deep and over, and nowhere less than 150 feet wide.

To complete the project there remains the widening of the channel to the full width of 350 to 400 feet, deepening it to 15 feet where that depth has not already been obtained, and revetting the banks where the channel excavation passes through meadow or upland.

PROPOSED OPERATIONS.

Future appropriations will be applied to widening and completing the channel as projected.

Harlem River is in the collection district of New York. The nearest light-house is Hell Gate, East River.

Money statement.

July 1, 1897, balance unexpended	$113,759.34
June 30, 1898, amount expended during fiscal year	103,768.28
July 1, 1898, balance unexpended	9,991.06
July 1, 1898, outstanding liabilities	595.93
July 1, 1898, balance available	9,395.13
Amount (estimated) required for completion of existing project	1,555,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

AMOUNTS APPROPRIATED.

Allotment June 23, 1874, from appropriations for East and Harlem Rivers	$11,000
Act of March 13, 1875	10,000
Total	21,000

AMOUNTS APPROPRIATED UNDER PRESENT PROJECT.

June 18, 1878	$300,000
March 3, 1879	100,000
August 11, 1888	70,000
September 19, 1890	250,000
July 13, 1892	175,000
August 18, 1894	125,000
June 3, 1896	125,000
Total	1,145,000

Abstract of proposals for improving Harlem River, New York—construction of stone retaining wall; received in response to advertisement dated September 13, 1897, and opened October 13, 1897.

No.	Name of bidder.	Concrete masonry in substructure; 230 cubic yards.		Rubble masonry in superstructure; 90 cubic yards.		Total amount.
		Per cubic yard.	Amount.	Per cubic yard.	Amount.	
1	Arthur McMullen	$20.00	$4,600.00	$7.00	$630.00	$5,230.00
2	Chas. Smedley	12.00	2,760.00	4.80	432.00	3,192.00
3	A. C. Gildersleeve	15.00	3,450.00	10.00	900.00	4,350.00
4	Henry C. Moore	10.00	2,300.00	9.00	810.00	3,110.00
5	Thomas H. Riddle	13.25	3,047.50	6.00	540.00	3,587.00
6	Ulrich Maurer Sons	a 10.50	2,415.00	7.50	675.00	3,090.00
7	Dennis Toomey	11.40	2,522.00	6.40	576.00	3,198.00
8	Frank Pidgeon	14.00	3,220.00	7.00	630.00	3,850.00
9	Bernard Rolf	14.30	3,289.00	5.00	450.00	3,739.00
10	Michael O'Sullivan	15.00	3,450.00	7.00	630.00	4,080.00
11	Hydraulic Construction Co	20.00	4,600.00	13.00	1,170.00	5,770.00

a Lowest bid in the aggregate.

CONTRACTS IN FORCE DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

1. Contract for dredging about 413,000 cubic yards of material from Harlem River and Spuyten Duyvil Creek, and for building about 800 linear feet of crib revetment. Name of contractor, Rittenhouse R. Moore; date of contract, September 26, 1896; date of approval October 20, 1896; date of beginning work, November 30, 1896; date of expiration of contract, June 30, 1898.

2. Contract for building about 40 linear feet of stone retaining wall. Name of contractors, Ulrich Maurer Sons; date of contract, November 1, 1897; date of approval, November 29, 1897; date of beginning work, November 6, 1897; expiration of contract, January 1, 1898.

COMMERCIAL STATISTICS.

The actual commerce of the Harlem River and Spuyten Duyvil Creek for the years 1893 and 1895 was as follows:

Items.	1893 (tons).	1895.	
		Tons.	Value.
General merchandise	3,232,052	3,473,581	$171,803,633
Grain, flour, feed, etc	596,306	767,851	15,238,420
Lumber and timber	451,702	633,194	7,839,116
Building material	602,217	1,526,043	4,698,294
Fuel	878,234	947,710	3,776,483
Ice	149,865	185,215	351,430
Total	5,910,376	7,533,594	203,707,376

The total tonnage for the year 1895 shows an increase over that of 1893 of 1,623,318 tons, or nearly 28 per cent, during the two years. Of the total tonnage 4,022,832 tons was received and shipped at the docks of the New York, New Haven and Hartford Railroad Company directly below Second Avenue Bridge, where also about 62,000 passengers were transferred in cars by the steamer *Maryland* to and from the New York, New Haven and Hartford Railroad to and from connecting lines terminating on the Hudson River at Jersey City. Of the balance, 28,101 tons was handled at various points on Spuyten Duyvil Creek, and 3,482,661 tons was received and shipped at the various docks on the Harlem River between its junction with the East River and Dyckman Cut.

As near as can be determined, the vessels engaged in the river traffic were as follows:

Canal boats, barges, and railroad-car floats	37,246
Sailing vessels, schooners, lighters, etc	5,483
Steamers and tugs, exclusive of pleasure boats	27,525

A large proportion of the freight handled at the docks of the New York, New Haven and Hartford Railroad Company is carried in and out of the Harlem River on railroad-car floats and transfer boats; and during the year 1895 335,236 loaded cars and 155,757 empty cars were thus received and shipped from these docks. Only the contents of these cars are included in the above tonnage, not the weight of the cars themselves.

There was also carried out of the river, on scows, 142,650 tons of ashes and other city refuse, which is not included in the above table.

BRIDGES ACROSS THE HARLEM RIVER.

The following table shows the location and characteristics of the several existing bridges across the Harlem River:

Name and location of bridge.	Width in clear in each draw.	Height of bottom chords above mean high water.	Remarks.
	Feet.	*Feet.*	
Second avenue	103.7	28.5	Double draw, railroad bridge, iron.
Third avenue (temporary)	61	4	Double draw, wooden trestle, iron drawspan.
Fourth avenue (temporary)	60	1	Single draw, wooden trestle, iron drawspan in process of removal.
Fourth avenue (permanent)	102	25.6	Double draw, railroad bridge, iron.
Madison avenue	132	25	Double draw, road bridge, iron.
Macombs Dam, One hundred and fifty-fifth street.	164	28	Do.
Macombs Dam, One hundred and fifty-sixth street (temporary).	76	16.7	Double draw, road bridge, wood. Order for removal within 90 days served by the Secretary of War on president of park board on April 12, 1897.
New York and Northern Railway Bridge, at Eighth avenue.	128	28	Double draw, railroad bridge, iron.
High Bridge (old aqueduct)	.....	.....	No draw; stone arch; width between piers, 77.7 feet; clear waterway, 55 feet; crown of arch, 100 feet above mean high water.
Washington Bridge, at One hundred and eighty-first street.	.....	Single span.	No draw; iron arch; span, 500 feet; clear waterway, 420 feet; crown of arch, 136.7 feet above mean high water.
Farmers Bridge	.....	3.1	No draw; two spans, 22 and 23 feet wide; light timber structure.
Kingsbridge	.....	4.8	No draw; two spans, 18 and 25 feet wide.
Bridge at Broadway, across improved channel.	104	26	Double draw, road bridge, iron; opened to traffic January 1, 1895.
Hudson River Railroad Bridge, at mouth of Spuyten Duyvil Creek.	50	6.9	Single draw, wooden trestle, iron drawspan; will shortly be replaced by iron truss bridge with double drawspan.

Under authority conferred by the river and harbor acts dated September 19, 1890, August 17, 1894, and June 3, 1896, rules and regulations for the opening and operating of the draws in the bridges crossing the Harlem River were prescribed by the Secretary of War May 14, 1898.

F 2.

IMPROVEMENT OF EAST RIVER AND HELL GATE, NEW YORK.

East River is the designation of the tidal strait which extends from The Battery to Throgs Neck, a distance of 16 miles, and connects New York Harbor with Long Island Sound. It is the harbor entrance used almost exclusively by the coasting trade between New York City and the New England States, and British American provinces.

The channel in places is crooked and narrow, and was originally obstructed by many rocks and reefs, over and around which the tide ran in strong eddying currents, with velocities at times as high as 6 miles per hour; even 10 miles has been recorded at single points. The most dangerous of these places is that known as Hell Gate, where the channel turns a right angle around Hallets Point, and where it was originally obstructed by several reefs, some bare at low tide, and others covered from 1 to 20 feet deep.

The mean rise of tide in East River below (south of) Hell Gate is 4½ to 5 feet; east of Hell Gate, where it is affected by the Long Island Sound tides, it is from 5 to 7 feet.

PROJECTS FOR IMPROVEMENT.

The project for improvement, adopted in 1867 and subsequently modified, provides for removal to a depth of 26 feet below mean low water of the following rocks in and near Hell Gate, viz: Hallets Point Reef (3 acres), Way Reef, Shell Drake, Pot Rock, Frying Pan, Heel Tap, Negro Point, Scaly Rock, and Middle Reef (which includes Flood Rock, Gridiron, Hen and Chickens, and Negro Heads), and of the following rocks south of Hell Gate: Ferry Reef and Charlotte Rock, off Thirty-fourth street, to 26 feet depth; Pilgrim Rock, off Nineteenth street, to 24 feet depth; Shell Reef, off Ninth street, to 18 feet depth; Coenties Reef and Diamond Reef, near the south end of East River, to 24 feet depth; and reef off Diamond Reef to 26 feet depth; and of the following, east of Hell Gate, viz: Reef off Sunken Meadow to 18 feet depth; North Brother Island Reef to 26 feet depth, and reef off Baretto Point to 24 feet depth; also for the building of four sea walls upon other ledges, to guide the course of the tidal currents. The total estimated cost was $5,139,120.

July 1, 1897, the following rocks had been removed to the required depth, viz: Hallets Point Reef, Way Reef, Shell Drake, Scaly Rock, Charlotte Rock, Pilgrim Rock, Coenties Reef, Diamond Reef, reef off Diamond Reef, North Brother Island Reef, and reef off Baretto Point. Shell Reef had been removed to the required depth, except at a few points; Middle Reef had been removed to 18–20 feet, Flood Rock being blasted to the required depth, but not entirely removed; Pot Rock, Frying Pan, and Heel Tap to 18–22 feet; Ferry Reef to 24 feet, and reef off Sunken Meadow to nearly the required depth. No work had been done upon Negro Point. A dike had been built between Great and Little Mill Rocks, Hell Gate, since used as a place for storing public materials and for laying up public vessels.

Further detailed descriptions of the locality, projected work, and work done are printed in the Annual Reports of the Chief of Engineers—

	Page.
For 1868	741
For 1874, Part II	164
For 1897	1026

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

At the beginning of the year work was in progress with one scow, belonging to the United States plant, removing shoal spots on the reef off Sunken Meadow. Work was continued until August 7, 1897, when the available funds were nearly used up.

During the year 31 tons of rock were removed. The depth over the reef was made 17.8 feet; the projected depth is 18 feet.

Since the close of operations the plant has been laid up at Mill Rock and cared for.

PRESENT CONDITION OF IMPROVEMENT.

The following table shows the rocks and reefs to be removed under the adopted project, with their distance from The Battery, and the original, present, and projected depths for each:

	Distance from The Battery.	Least original depth.	Least present depth.	Projected depth.	
	Miles.	*Feet.*	*Feet.*	*Feet.*	
Diamond Reef	½	17	26	24	Completed.
Reef off Diamond Reef	½	19	26	26	Do.
Counties Reef	½	14.3	25.5	24	Do.
Shell Reef, off Ninth street	3½	7.5	a 18	18	
Pilgrim Rock, off Nineteenth street	4	12	24	24	Do.
Ferry Reef, off Thirty-fourth street	4½	7	24	26	
Charlotte Rock, off Thirty-fourth street	4½	14.7	26.5	26	Do.
Middle Reef, including Flood Rock, Gridiron, Hen and Chickens, and Negro Heads.	7	+6.0	18 to 20	26	
Hallets Point	7½	+4.0	26	26	Do.
Heel Tap	7½	12.1	20.5	26	
Frying Pan	7½	11	18.0	26	
Pot Rock	7½	20	22.8	26	
Way Reef	7½	17.4	26	26	Do.
Shell Drake	7½	18.3	26	26	Do.
Scaly Rock	7½	.....	26	26	Do.
Negro Point	7½	.....	.....	26	
Reef off Sunken Meadow	9	11	17.8	18	Nearly completed.
North Brother Island Reef	10	16	26	26	Completed.
Reef off Baretto Point	11	17	24	24	Do.

a Nearly.

The depth proposed in the original project was 24 feet below mean low water. Subsequently the projected depth was increased to 26 feet for all the rocks in and near Hell Gate and for some of the others.

Shell Reef and reef off Sunken Meadow are large reefs, not directly in the main channel; when the project was extended to include work upon these their proposed depth was placed at 18 feet.

PROPOSED OPERATIONS.

Future appropriations should be applied to completion of the work contemplated under the adopted project.

This work is in the collection district of New York. The light-houses at Hell Gate, North Brother Island, and Blackwell's Island are close to the channel of East River, and Fort Columbus, New York Harbor, is near the East River entrance.

Money statement.

July 1, 1897, balance unexpended	$13,956.14
June 30, 1898, amount expended during fiscal year	12,408.65
July 1, 1898, balance unexpended	1,547.49
Amount (estimated) required for completion of existing project	753,840.67
Amount that can be profitably expended in fiscal year ending June 30, 1900	200,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

AMOUNTS APPROPRIATED.

Act of—		Act of—	
July 25, 1868	$85,000.00	May 4, 1882	$50,000.00
April 10, 1869	178,300.00	August 2, 1882	200,000.00
July 11, 1870	250,000.00	July 5, 1884	360,000.00
March 3, 1871	250,000.00	August 5, 1886	112,500.00
June 10, 1872	225,000.00	August 11, 1888	250,000.00
March 3, 1873	225,000.00	September 19, 1890	200,000.00
June 23, 1874	225,000.00	July 13, 1892	150,000.00
March 3, 1875	250,000.00	August 18, 1894	75,000.00
August 14, 1876	250,000.00	June 3, 1896	60,000.00
June 18, 1878	350,000.00	Net receipts from other sources	3,637.88
March 3, 1879	250,000.00		
June 14, 1880	200,000.00		
March 3, 1881	200,000.00	Total	4,399,437.88

Deduct amount reverted to United States Treasury	$3,158.55	
Deduct amount allotted to Harlem River	11,000.00	
		14,158.55
		4,385,279.33
Amount expended to June 30, 1898		4,383,731.84

COMMERCIAL STATISTICS.

The commerce of the East River is so intimately connected with that belonging to New York Harbor proper that it is impracticable to make a separate statement of it.

F 3.

IMPROVEMENT OF NEW YORK HARBOR, NEW YORK.

New York Harbor is the general designation of the water front of and approaches to the city of New York, comprising the Upper and Lower bays and parts of the Hudson, East, and Harlem rivers.

New York Harbor has two entrances, one from Long Island Sound by East River and Hell Gate, used by vessels trading eastward between New York, the Eastern States, and British American provinces; the other, the main entrance from the sea by Sandy Hook, through the Narrows, used by trans-Atlantic and Southern traffic. The title "Improvement of New York Harbor" has been applied to improvement of the channel of the main entrance from the sea.

From the Battery, at the lower end of New York city, out through the Narrows to the Lower Bay, a total distance of about 9 miles, there is a natural channel fairly broad and unobstructed, with available depths of 45 feet or more at mean low tide. The Lower Bay is separated from deep water of the ocean by a bar from 2 to 5 miles across, which, except for the channels crossing it, extends all the way from Sandy Hook to the west end of Coney Island, a distance of 7 miles. On the west side of this bar the Main Ship Channel extends southward from the Narrows to Sandy Hook, with natural depth of 23.3 feet, since opened.

Five distinct natural channels, separated by sand shoals, cross this bar, in order as follows, from the north or Coney Island Shore.

(1) The Coney Island Channel, straight, narrow, with a general depth of 20 feet except at the west end, where the available depth is but 10 feet. South of this channel lies a shoal known as East Bank, with least depth of 6 feet.

(2) The Fourteen-foot Channel, a curving channel with considerable depths in the west part, but with only 15 feet depth at the eastern end. To the south lies a shoal with 5½ feet least depth.

(3) The East Channel, a broad, nearly straight channel of 30 feet depth or more in the western part, separated from deep water on the east by a bar having only 19 feet depth. South of this channel lies Romer Shoal, with 3 feet least depth.

(4) The Swash Channel, with 22 feet depth in a narrow channel. To the south lies a shoal called Flynns Knoll, with least depths of 11 feet.

(5) The Main Channel, a broad channel passing close to the north shore of Sandy Hook, with natural available depths of 28 feet.

The southern part of the Main Ship Channel, with the Swash and Main channels, form nearly an equilateral triangle, the two last named intersecting in a deep hole of considerable area rather more than midway across the bar. Outside this deep hole the bar was about 20 feet deep and was crossed by two channels, the north, called Gedney Channel, about 1½ miles long to deep water, and the south, called South Channel, somewhat longer, extending southeast nearly in continuation of the Swash Channel. Gedney and South channels both had natural depths of 24 feet.

Thus the natural channels afforded an available low-water depth from the ocean to the lower wharves of New York City of 23.3 feet, the distance from the outer side of the outer bar being 21 miles.

PROJECT FOR IMPROVEMENT.

This project, adopted in 1884 and subsequently extended, consisted in making a channel 1,000 feet wide and 30 feet deep at mean low water from New York Harbor to deep water in the Atlantic by way of Sandy Hook, at an estimated cost of $1,490,000. Work was begun September 26, 1885, and the project was completed October 10, 1891. Appropriations since that time have been applied to maintaining the channel by increasing its width and by removing shoals.

Under special projects between 1863 and 1894 small allotments from various appropriations have been from time to time expended in protecting the north shore of Sandy Hook by building jetties from high-water mark out to below low water and by building riprap sea walls alongshore just below high-water line.

Further detailed descriptions of the harbor and of the project for improvement are printed in the Annual Reports of the Chief of Engineers for 1885, page 773, and for 1897, page 1031.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

At the beginning of the year the U. S. dredge *Gedney* was being fitted with new boilers, under contract with the Harlan & Hollingsworth Company, dated March 3, 1897. After the boilers were tested the dredge resumed work of removing shoals and widening the channel, and during the year 180,111 cubic yards of material were dredged, removing a shoal in the west side of the Main Ship Channel between buoy C 3 and Southwest Spit and widening the channel through Northwest Shoal. The channel through this shoal was widened 500 feet on the north side and 200 feet on the south side, and now there is a channel of the full depth (30 feet at mean low water) across the entire shoal, with width of 1,000 feet north of the channel range and 700 feet width south of that range.

The cost per yard of dredging during the past fiscal year, including extensive repair and maintenance of plant, was 17.7 cents; the average cost per yard since purchase of plant, December 1, 1892, has been 11.1 cents, all expenses included.

The resurvey of the harbor from the Narrows to the sea, authorized by the Secretary of War May 13, 1897, was made, and the map was sent to the Chief of Engineers with report dated April 5, 1898.

PRESENT CONDITION OF IMPROVEMENT.

The improved channel from deep water below the Narrows to deep water beyond the bar has a depth of 30 feet at mean low water and general width of 1,000 feet throughout. At Northwest Shoal the 30-foot channel has been widened to 1,700 feet by the operations of the year.

PROPOSED OPERATIONS.

Future appropriations under the completed project should be applied to removing such shoals as form from time to time in the channel, and to increasing the width of channel, especially at places where shoals are most liable to be formed.

This work is in the collection district of New York. Nearest light-houses, Sandy Hook and Highland lights. The nearest forts are the fort at Sandy Hook and those at the Narrows.

Money statement.

July 1, 1897, balance unexpended	$72,978.28
Amount received since	9,600.00
	82,578.28
June 30, 1898, amount expended during fiscal year	53,349.90
July 1, 1898, balance unexpended	29,228.38
July 1, 1898, outstanding liabilities	3,013.91
July 1, 1898, balance available	26,214.47
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	500,000.00

AMOUNTS APPROPRIATED.

For Gedney Channel, by act July 5, 1884	$200,000.00
For New York Harbor:	
Act August 5, 1886	750,000.00
Act August 11, 1888	380,000.00
Act September 19, 1890	160,000.00
Act July 13, 1892	170,000.00
Act August 18, 1894	75,000.00
Act June 3, 1896	60,000.00
Total	1,795,000.00
Received from other sources	28,024.52
	1,823,024.52
Amount expended to June 30, 1898	1,793,796.14

CONTRACT IN FORCE DURING THE FISCAL YEAR ENDING JUNE 30, 1898.

With the Harlan & Hollingsworth Company, for furnishing two boilers for the U. S. S. *Gedney*, at cost of $12,270; date of contract, May 3, 1897; approved by the Chief of Engineers, June 4, 1897; expiring under extension November 15, 1897.

Work begun May, 1897; completed November 13, 1897.

COMMERCIAL STATISTICS.

The following statement concerning foreign commerce of the port of New York is taken from the annual report of the Chamber of Commerce of the State of New York for the year 1897-98. It comprises only foreign imports and exports, and does not include the domestic, coastwise, and local traffic. Vessels trading with domestic ports are not required to take out clearance papers, and no attempt is made to collect statistics of their carrying trade.

The leading articles of import into the United States at the port of New York for the year ending June 30, 1897, were sugar, molasses, coffee and tea, wool, cloths and dress goods, leather and leather goods, tin, rubber, tobacco, and other miscellaneous articles, aggregating about two and one-half million tons, valued at $556,948,811.

The leading articles of export were cotton, breadstuffs and other provisions, oils, tobacco, metals, manufactures, and other miscellaneous items, aggregating about three and one-half million tons, valued at $467,624,806.

Statement of the number and tonnage of all vessels belonging to the port of New York June 30, 1897.

	Number.	Tonnage.
Steam vessels	1,135	510,323.70
Sailing vessels	1,678	346,354.20
Canal boats	228	29,145.02
Barges	741	166,118.08
Total	3,782	1,051,941.00

F 4.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

1. *Steamship Ailsa.*—The British iron steamship *Ailsa* was struck during a fog on February 29, 1896, by the steamer *La Bourgogne*, in or near the Narrows, New York Harbor. She steamed toward the east shore and sank in 40 feet of water on the east side of the Narrows, below Fort Hamilton. At the beginning of the fiscal year removal of this wreck was in progress under a contract entered into with John W. Chittenden, dated May 4, 1897; contract price, $11,975. The contract was extended from August 25 to November 25, 1897. Work was continued during the summer and fall, and November 15, 1897, the wreck was finally removed to the depth of the surrounding bottom, 40 feet below mean low water.

Sealed proposals for the sale of material recovered from the wreck were invited; the only bid received was one of $1,000 made by the contractor for the removal of the wreck. Supplementary articles of agreement were made, deducting the amount bid for material from the contract price for removal, approved by the Secretary of War, September 14, 1897.

CONTRACT IN FORCE DURING THE FISCAL YEAR ENDING JUNE 30, 1898, FOR REMOVAL OF WRECK OF STEAMER AILSA.

Name of contractor: John W. Chittenden.
Date of contract: May 4, 1897.
Date of approval of contract: June 1, 1897.
Date of beginning work: June 1, 1897.
Expiration of contract, under extension: November 25, 1897.

Articles of agreement supplementary to above, providing for sale of recovered materials for $1,000, to be deducted from contract price, dated August 5, 1897; approved by the Secretary of War, September 14, 1897.

2. Steamship Alvena.—The British iron steamship *Alvena* sank in New York Harbor in the angle between Gedney and South channels, after collision with the steamer *British Queen*, January 19, 1897. She lay in about 25 feet depth of water, and was a serious danger to navigation.

Prior to July 1, 1897, proposals for removal of this wreck had been invited, and the lowest bid accepted. On July 15, 1897, a contract was entered into with John W. Chittenden, approved by the Chief of Engineers July 27, 1897, for removal of the wreck of the *Alvena* for the sum of $36,000, the work to be completed November 24, 1897. Work was begun August 4, 1897. On the same day sealed proposals for recovered material were opened; the only bid received was one by the contractor for removal, offering $2,200 for this material. With approval of the Secretary of War, dated September 17, 1897, supplementary articles of agreement were entered into with the contractor, September 23, 1897, providing for deduction of the amount of bid for material from the contract price for removal of the wreck. With approval of the Chief of Engineers, the contract has been extended to November 24, 1898.

Work of removal was continued during the fiscal year. The only effective time for operations generally is at or near slack water, and much time has also been lost from fogs and rough weather. Up to July 1, 1898, the amount of work accomplished is estimated at about 60 per cent of the whole work of removal.

CONTRACT IN FORCE DURING THE FISCAL YEAR ENDING JUNE 30, 1898, FOR REMOVAL OF WRECK OF STEAMSHIP ALVENA.

Name of contractor: John W. Chittenden.
Date of contract: July 15, 1897.
Date of approval of contract: July 27, 1897.
Date of beginning work: August 4, 1897.
Expiration of contract, under extension: November 24, 1898.

Articles of agreement supplementary to the above, providing for sale of materials recovered, for the sum of $2,200, to be deducted from the contract price, dated September 23, 1897; approved by the Secretary of War September 17, 1897.

APPENDIX G.

IMPROVEMENT OF RIVERS AND HARBORS IN VERMONT; OF PEEKSKILL, RONDOUT, AND SAUGERTIES HARBORS, AND OF HUDSON RIVER, NEW YORK; AND OF RIVERS AND HARBORS IN NORTHEASTERN NEW JERSEY.

REPORT OF MAJ. A. M. MILLER, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1898, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Burlington Harbor, Vermont.
2. Otter Creek, Vermont.
3. Narrows of Lake Champlain, New York and Vermont.
4. Hudson River, New York.
5. Saugerties Harbor, New York.
6. Rondout Harbor, New York.
7. Peekskill Harbor, New York.
8. Passaic River, New Jersey.
9. Channel between Staten Island and New Jersey.
10. Elizabeth River, New Jersey.
11. Raritan River, New Jersey.
12. South River, New Jersey.
13. Raritan Bay, New Jersey.
14. Matawan Creek, New Jersey.
15. Keyport Harbor, New Jersey.
16. Shoal Harbor and Compton Creek, New Jersey.
17. Shrewsbury River, New Jersey.
18. Manasquan (Squan) River, New Jersey.
19. Removing sunken vessels or craft obstructing or endangering navigation.

HARBOR LINES.

20. East shore of Hudson River, in front of the city of Yonkers, N. Y.

UNITED STATES ENGINEER OFFICE,
New York City, July 6, 1898.

GENERAL: I have the honor to forward herewith annual report upon works of river and harbor improvement in my charge for the fiscal year ending June 30, 1898.

Very respectfully, your obedient servant,

A. M. MILLER,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

G 1.

IMPROVEMENT OF HARBOR AT BURLINGTON, VERMONT.

[This work was in the charge of Maj. W. S. Stanton, Corps of Engineers, until October 1, 1897.]

The improvement of this locality consists in forming an artificial harbor in front of the city by constructing a breakwater about 1,000 feet from the shore.

The method of construction has consisted in first placing a stone mound along the proposed line, the width on top being sufficient to support wooden cribs, which were sunk into position and filled with stone. Until 1890 the breakwater was built of timber to its full height of 8 feet above low water. Since then it has been built with a stone superstructure above low water.

The present length of the breakwater is 4,163 linear feet. Maps showing its location and cross sections of the stone superstructure are printed in the Report of the Chief of Engineers for 1897, following page 3298.

A contract was entered into during the previous fiscal year with Edgar S. Fleury, of Isle Lamotte, Vt., for building a stone superstructure on a portion of the breakwater 34 feet wide, at a cost of $31.50 per linear foot. Work under this contract began August 1, under the supervision of Mr. F. M. Barstow, assistant engineer, and was completed November 15, 1897, 235 linear feet of stone superstructure having been constructed.

While work was in progress it was found that in some places the outward thrust against the front side of the cribs was greater than the wooden cross-ties would stand. It therefore became necessary to introduce iron tie-rods, in order to give the crib work sufficient strength.

To complete this improvement 897 linear feet of breakwater remains to be built at its present southerly end and 2,695 linear feet of stone superstructure is to be erected.

Money statement.

July 1, 1897, balance unexpended	$10,367.81
June 30, 1898, amount expended during fiscal year	10,161.39
July 1, 1898, balance unexpended	206.42
Amount (estimated) required for completion of existing project	230,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

Appropriations.

By act of—		By act of—	
July 4, 1836	$10,000.00	August 14, 1876	$20,000.00
March 3, 1837	10,000.00	June 18, 1878	20,000.00
July 7, 1838	50,000.00	March 3, 1879	15,000.00
June 11, 1844	10,000.00	June 14, 1880	10,000.00
August 30, 1852	10,000.00	March 3, 1881	10,000.00
May 19, 1864	308.00	August 2, 1882	12,000.00
June 28, 1864	13,500.00	July 5, 1884	50,000.00
June 23, 1866	27,672.20	August 5, 1886	18,750.00
March 2, 1867	80,000.00	August 11, 1888	35,000.00
July 11, 1870	25,000.00	September 19, 1890	20,000.00
March 3, 1871	30,000.00	August 18, 1894	10,000.00
June 10, 1872	30,000.00	June 3, 1896	10,000.00
March 3, 1873	25,000.00		
June 23, 1874	25,000.00	Total	602,230.20
March 3, 1875	25,000.00		

NOTE.—In 1872, $6,669.13 was carried to surplus fund and not expended.

COMMERCIAL STATISTICS.

Vessels employed in trade.

Class.	Number.	Registered tonnage.	Trips made.
Steam	18	10 to 1,011	504
Sail	20	38 to 145	102
Canal boats and barges	304	60 to 179	432

Greatest length, 261 feet; greatest draft, 10 feet.

Freight handled.

Articles.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*
Coal	68,383	71,888	44,597
Lumber and timber	37,162	23,193	36,342
Stone, gravel, and sand	36,183	18,126	2,079
General merchandise	38,618	32,774	26,162
Total	180,346	145,981	109,180

G 2.

IMPROVEMENT OF OTTER CREEK, VERMONT.

[This work was in the charge of Maj. W. S. Stanton, Corps of Engineers, until October 1, 1897.]

This improvement was undertaken in order to provide an 8-foot channel, 100 feet wide, from Lake Champlain to Vergennes.

At the close of the previous fiscal year a channel of the desired depth and 40 feet wide had been secured.

No work was done during the present fiscal year owing to the lack of funds. A detailed statement of work done can be found in the Report of the Chief of Engineers for 1897, page 3299.

It has been found necessary to redredge some of the shoals where accretions have occurred during seasons of freshets. Occasional expenditures for maintenance will doubtless be required after completion of the work. Such cost will be small compared to the first cost of the improvement and the traffic benefited.

Money statement.

July 1, 1897, balance unexpended	$8.48
June 30, 1898, amount expended during fiscal year	8.48
Amount (estimated) required for completion of existing project	12,248.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

Appropriations.

By act of—		By act of—	
June 10, 1872	$10,000	August 11, 1888	$2,500
March 3, 1875	5,000	September 19, 1890	5,000
June 18, 1878	8,000	July 13, 1892	10,000
March 3, 1879	5,000	August 18, 1894	5,000
June 14, 1880	2,000	June 3, 1896	5,000
March 3, 1881	2,000		
August 2, 1882	2,000	Total	61,500

COMMERCIAL STATISTICS.

Vessels engaged in trade.

Class.	Number.	Tonnage.	Draft.
Steam	3	12,080	6
Canal boats and barges	85	7,700	6

Freight handled.

Articles.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*
Coal	5,000	5,000	5,000
Lumber	3,000	2,352	1,080
Iron	2,300	800	1,050
Kaolin	1,000	450	300
General merchandise	1,375	450	250
Total	12,675	9,052	7,680

G 3.

IMPROVEMENT OF NARROWS OF LAKE CHAMPLAIN, NEW YORK AND VERMONT.

[This work was in the charge of Maj. W. S. Stanton, Corps of Engineers, until October 1, 1897.]

This improvement consists in widening and deepening the channel from Whitehall, N. Y., the northern terminus of the Champlain Canal, to Bensons Landing, Vt., a distance of 15 miles.

Under various appropriations the depth of the channel has been increased to 12 feet, but at the close of the last fiscal year a shoaling had occurred in places, which restricted the draft which vessels could carry to not exceeding 10 feet.

No work was done during the present year, owing to lack of funds and to the completion of the project under which operations were carried on.

An examination of the channel from Whitehall to Bensons Landing, made in the fall of 1896, disclosed the fact that the channel, dredged from 1887 to 1889, had shoaled from 1 to 2 feet, and that, in order to restore the 12-foot channel, it would require the removal of 60,000 cubic yards of material, measured in place. In addition, a widening and deepening of the channel was required at other places, which would necessitate the dredging of 40,000 cubic yards of material, measured in place.

Vessels were also damaged through colliding with the rocky bluffs at Puts Rock, a few hundred feet below the "Elbow," where the waterway is only about 100 feet wide. This can be prevented by bolting fender timbers to the rough faces of the rock. Fender piles are also needed for about 60 feet along the rocky bluffs at the Narrows, and for about 30 feet at Pulpit Point.

The total quantity of material to be removed, adding 30 per cent for scow measurement, would amount to 130,000 cubic yards. The estimated cost of completing this improvement is therefore as follows:

Dredging 130,000 cubic yards of material, at 15 cents	$19,500
Fender timbers and piles	1,500
Contingencies and engineering expenses	1,500
Total	22,500

In addition, it is estimated that it will require $5,000 every two years to maintain the improvement after completion.

These facts are presented in accordance with authority contained in letter from the Chief of Engineers, dated October 10, 1896.

Money statement.

July 1, 1897, balance unexpended	$15.51
June 30, 1898, amount expended during fiscal year	15.51
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	25,000.00

Appropriations.

By act of—	
August 5, 1886	$30,000
August 11, 1888	15,000
July 13, 1892	18,500
Total	63,500

COMMERCIAL STATISTICS.

Number of boats and tows passing Whitehall, N. Y., during the years 1895, 1896, and 1897.

	1895.	1896.	1897.
Number of tows	304	252	226
Number of boats towed	5,168	4,032	3,621
Total tonnage	826,880	604,800	519,873

G 4.

IMPROVEMENT OF HUDSON RIVER, NEW YORK.

[This work was in the charge of Brig. Gen. William Ludlow (now Maj. Gen.), United States Volunteers, lieutenant-colonel, Corps of Engineers, until October 1, 1897.]

The portion of this river now under improvement by the United States extends from the State Dam at Troy downstream to Coxsackie. The object is to provide navigation with a 12-foot channel 300 feet wide from the State Dam to the foot of Broadway, Troy, and 400 feet wide from Broadway, Troy, to Coxsackie. Below this latter point there is ample depth and width of channel.

The Report of the Chief of Engineers for 1885, page 677 et seq., contains a history of this work, accompanied by original reports and two sketches, showing its condition at that time.

The report of the Board of Engineers, who formulated the present project, is contained in the Report of the Chief of Engineers for 1892, page 750 et seq.

Other information in regard to this improvement, including a tabulated statement of the condition of the channel on June 30, 1897, is contained in the Report of the Chief of Engineers for 1897, page 997 et seq.

WORK DONE DURING THE PRESENT FISCAL YEAR.

At the beginning of the present fiscal year work was in progress under the following contracts:

With Edwards, Howlett & Thompson, for dredging.

With P. Sanford Ross, for breaking up and removing rock and sand covering rock.

With William Parrott, for constructing new and repairing old dikes.

Under the contracts with Edwards, Howlett & Thompson the dredging between Albany and the foot of Broadway, Troy, was continued until November 20, 1897, when all the dredges were withdrawn from that section of the river and removed to New Baltimore Bar, two large dredges having been previously removed to Mulls Cross-over on October 15 and 19, respectively.

The dredging above Albany was restricted to the excavation of a channel, generally 200 feet wide and 12 feet deep, between the south end of Cuylers Island and the foot of Broadway, Troy, it being considered advisable to complete a narrower channel through to the latter point rather than to make the full 400 feet width for only a portion of the distance, and to opening a channel about 250 feet wide through a shoal in front of Bath-on-the-Hudson, where, though previous dredging had procured a depth of 12 feet, it had filled up so as to leave only 10.5 feet. In front of Albany, both above and below the New York Central and Hudson River Railroad lower or passenger bridge, the channel was widened in order to open the approaches to the west draw span, and was dredged to a depth of 12 feet. At Mulls Cross-over a shoal on the west side of the proposed channel, which had been left when dredging had been previously done, on account of the tendency to re-form as long as the reef of rock above it was not removed, was dredged to a depth of 12 feet, except at a point on the extreme western edge, the rock removal having been completed except at that point. At New Baltimore Bar, in the vicinity of Willow Island Light, the channel having shoaled badly, thereby obstructing navigation, dredges were employed to restore the depth to 12 feet. Three dredges began work November 13, and when dredging was suspended for the season on December 3, 1897, on account of the formation of ice, the removal of the shoals had been only partially completed.

Three large and two small dipper dredges were employed during the whole season, and about November 9 the number was increased by the addition of three small dredges. The material removed between the north end of High Dike and the foot of Broadway, Troy, was very varied in character. On the east side of the channel, through Covills Folly to the bend opposite Breaker Island, a large proportion of the material was cobblestones, bowlders, clay, and coarse gravel, while on the west it was coarse sand, gravel, and cobblestones. On Van Buren and Washington bars only a small proportion was heavier than coarse gravel, but from the north end of Washington Bar to the Congress Street Bridge the material was very heavy, being largely composed of bowlders and cobblestones.

May 20, 1898, the contractors resumed work with one large and one small dredge, which were employed in widening the channel at Troy between the north end of Washington Bar and Congress Street Bridge, and after removing 50,107 cubic yards completed their contract on June 28 and withdrew their plant from the work.

The dredged material was disposed of by using one 15-inch centrifu-

gal pump the whole of the season of 1897 and one vacuum pump for a few weeks at the end of it, which together lifted 51,433 cubic yards of material and deposited it behind dikes or bulkheads at New Baltimore, Cedar Hill, Douws Point, and Troy, and by dumping directly from the scows 482,682 cubic yards in the "Imbought" dumping ground and 3,767 cubic yards behind the Campbell Island Dike, below Staats Point.

The prices paid for dredging the light material was 20.7 cents and for the heavy material 38 cents per cubic yard.

Under the contract with P. Sanford Ross the removal of rock and sand covering rock was continued until November 26, 1897, when the total amount of work contemplated under this contract was completed and the plant withdrawn from the work.

The method employed to break the rock prior to its removal was the same as that employed during the previous seasons under this contract, which is described in the Report of the Chief of Engineers for 1893, page 1013, except that a portion of it was broken by blasting. Three machines or "rock breakers" and one scow, with a single drill mounted, were used during the season to break up the rock, and two clam-shell dredges were used to remove the rock as well as the sand covering.

The large reef of rock within the limits of the proposed channel at Mulls Cross-over and the reefs on the west side of the river between Thirteenth and Fifteenth streets, Watervliet, and on the east side between Congress and State streets, Troy, which were in process of removal at the end of the last fiscal year, and several small reefs developed while dredging opposite Breaker Island, were entirely removed; but the removal of the reefs opposite the United States Arsenal wharf at Watervliet, and between State street and Broadway, Troy, was not completed when the limit of the contract was reached. The least depth on these reefs within the limits of the dredged channel was, however, increased to not less than 10.5 feet.

As the dredging progressed at Troy new reefs of rock were developed, some of which still remain to be removed. From the southerly line of the United States Arsenal, Watervliet, to the State Dam at Troy no accurate estimate of the quantity of rock which will have to be removed can be made until the channel has been dredged to its full width, as the rock seems to lie very near the plane of 12 feet below mean low water and undulates above and below that plane over a very large area.

Under the contract with William Parrott the construction and repair of dikes was continued and the contract completed December 14, 1897.

A contract was entered into with William D. Fuller on October 2, 1897, for the delivery of rubble and paving stone for repairing dikes. This contract was completed June 20, 1898.

The progress of the work done during the fiscal year may be summarized as follows:

CONSTRUCTION OF NEW DIKES.

Under contract with William Parrott the following dikes have been constructed:

Extension of Papscanee Dike, Section II, 1,437 feet long, closing the gap between Sections II and III, was completed October 19, 1897. It is a full dike, 7 feet wide from out to out of piling, and cost $5.85 per linear foot.

Extension of Papscanee Dike, Section I, 817 feet long, closing the gap between Sections I and II, is also a full dike 7 feet wide, and was completed October 22, 1897, at a cost of $5.73 per linear foot.

REPAIRS OF EXISTING DIKES.

Under the contract of William Parrott, the following dikes were repaired:

Papscanee Dike, Section I.—A portion of this dike, 1,249 feet long, was originally a single-pile dike, with stone thrown on both sides of the piling. It was nearly destroyed, and was rebuilt on the plan of a full dike, 7 feet wide, using the remains of the old piling as much as possible. This work was completed October 23, 1897, at a cost of $4.17 per linear foot.

Douws Point dike extension.—A portion of this dike, 1,150 feet long, which was also a single-pile dike, was repaired on the same plan as the above-mentioned dike, and was completed December 14, 1897, at a cost of $3.60 per linear foot.

Under the contract with William D. Fuller, rubble and paving stone was delivered as follows for the repairing of dikes:

Corsackie Island Half-dike.—109.6 cubic yards of rubblestone was used in refilling a section of about 180 feet long, at the south end adjoining the ice-house wharf; also a section about 30 feet long, on the west side of the island, and 400 cubic yards were placed outside the piling at two places to protect the piling from further scouring effects of the currents, at a cost of $479.02.

Lighthouse Island Half-dike.—50.4 cubic yards of rubblestone was used in refilling a section about 100 feet long at the south end, adjoining the ice-house wharf, and also a section about 150 feet long on the west side of the island, and 94 cubic yards were placed outside of the piling at the latter place to protect the piling from further scouring effects of the currents, at a cost of $135.73.

Mulls Island Half-dike.—253.3 cubic yards of rubblestone to refill 593 linear feet, at a cost of $238.10.

Mulls Dike.—515 cubic yards of rubblestone to refill 2,500 linear feet, at a cost of $484.10.

Upper Schodack Island Half-dike.—828 cubic yards of rubblestone to refill 1,760 linear feet, at a cost of $778.33.

Cedar Hill Dike (Poplar Island).—308.3 cubic yards of rubblestone to refill 980 linear feet, at a cost of $289.90.

Campbell Island Half-dike.—319.4 cubic yards of rubblestone to refill 1,150 linear feet, at a cost of $300.24.

Bogart Island Dike.—427.4 cubic yards of rubblestone to refill 1,300 linear feet, at a cost of $401.76.

Patroons Island Revetment.—30 cubic yards of paving stone for repairs of paving, at a cost of $58.50.

Breaker Island Revetment.—1,310.2 cubic yards of paving stone for repairing paving, at a cost of $2,448.22.

Port Schuyler Dike.—665.2 cubic yards of paving stone for repairing paving, at a cost of $1,297.13.

The following quantities of material were furnished for dike construction and repairs, viz:

Pine piling	linear feet	52,792
Square timber	feet, B. M.	119,188
Tie rods and screw bolts	pounds	37,070
Drift bolts, spikes, and washers	do	24,776
Rubblestone	cubic yards	7,806.3
Paving stone	do	2,005.4

DREDGING.

Under the contract with Edwards, Howlett & Thompson, the dredging which was in progress at the end of the last fiscal year between Patroons Island and the foot of Broadway, Troy, was continued until a channel generally 200 feet wide and 12 feet deep was obtained, except where rock was encountered above that plane.

The following table shows the quantities of material removed from the channel at the different localities during the year, viz:

	Cubic yards.
New Baltimore Bar	49,299
Mulls Cross-over	51,489
Castleton Bar	7,052

	Cubic yards.
Bogart Light Shoal	1,310
In front of Albany	8,549
Bath Shoal	75,746
Round Shoal	5,732
Covills Folly	7,083
Opposite Breaker Island	46,885
Van Buren Bar	32,193
Washington Bar	51,990
Opposite Watervliet Arsenal	101,346
Arsenal to Congress street, Troy	60,864
Congress street to foot of Broadway, Troy	30,935
Total	530,473

REMOVAL OF ROCK.

Under the contract with P. Sanford Ross, the work of removing all rock from the channel above the 12-foot plane, also the sand covering it, which was in progress at the end of the last fiscal year, was continued until the total amount provided for under the contract was removed.

The following table shows the quantities of rock and sand covering rock which were removed from the various reefs during the fiscal year, viz:

Locality.	Rock.	Sand covering rock.
	Tons.	*Tons.*
Mulls Rock	467.4	.....
Covills Folly Reef, No. 1	2,548	467
Covills Folly Reef, No. 2	537	163
Breaker Island Reef B	25	62
Arsenal Reef	4,385.9	1,061.2
Adams Street Reef	652	85
West Troy Reef	167	28
Congress Street Reef	22,532	1,078
Broadway Reef	14,602	1,841
Total	45,916.3	4,779.2

WRECKS.

During the fiscal year three wrecks were removed from the channel of the river at the following localities:

By authority dated August 28, 1897, the remains of a canal boat or barge, lying near the dike on the east side of the river, opposite Bogart Light, about 2 miles below Albany, was removed at a cost of $197.

By authority dated September 28, 1897, the remains of an old canal boat lying on the west side of the river, opposite Stone House Bar, about 16 miles below Albany, was removed at a cost of $179.

By authority dated January 12, 1898, the remains of the burned tugboat *R. H. Vandecar*, lying on the east side of the river, nearly opposite the lower side cut to the Erie Canal at Port Schuyler, about 5¼ miles above Albany, was removed at a cost of $175.

HIRED LABOR.

A foreman and 8 laborers were employed during the month of July, 1897, in replacing and leveling stone filling of the dikes in the vicinity of Castleton. Early in the month of August the number of laborers was increased to about 48, and continued at about that number until the latter part of the month of November, the whole force being discharged on December 3, 1897.

The total cost of this work was $7,819.19.

HYDROGRAPHIC WORK.

The hydrographic party was employed in making surveys and exam inations before and after dredging and rock removal, and in settin ranges and tide staffs for dredging and rock removal.

Guide piles were driven to mark dikes near the channel, therefor dangerous to navigation in times of freshets, at a cost of $88.41.

GENERAL REMARKS.

During the spring and summer of 1897 rains kept the water in th river in a state of freshet so much of the time that the tidal observa tions were not of much value for determining the changes which th dredging is causing in the tides. The means of the staff readings du ing two months in the fall, when the river was comparatively free fro freshets, have been selected for a comparison with the tides of previou seasons and the results shown in the following table, the elevations o the high and low water being above that of similar tides at Governor Island, New York. The results of previous tidal observations are co tained in the Report of the Chief of Engineers for 1897, page 998.

Locality.	Elevation of mean low water.	Elevation of mean high water.	Mean ris and fall of tid
	Feet.	*Feet.*	*Feet.*
At Albany	2.39	0.87	2.8
At nail works	2.53	1.04	2.8
At Broadway, Troy	2.53	1.03	2.8
At State Dam, Troy	4.17	1.28	1.4

A comparison of the above results with those deduced from the tida observations in 1873 and 1876 shows a lowering of the plane of mea low water of 0.04 foot at Albany, 0.45 at nail works, 0.59 at Broadway Troy, and 0.36 at State Dam, and an increase in the mean range of th tides of 0.54, 0.94, 0.88, and 0.64 foot, respectivel .

The surveys of the channel which have been made since the openin of navigation this season have given a great deal of valuable informa tion, as to the probable stability of the dredged channels. A compari son of the maps of these surveys with those made soon after th dredging was done has been made, with the following results:

At Coxsackie Shoal, where a channel was dredged to a depth of 1 feet and 400 feet wide in 1895, the width has been reduced to 100 feet It seems evident that the required channel can not be maintaine through this shoal without a dike on the west side about 2,500 fee long to support it.

At Stone House Bar there has been a marked shoaling, and there i no through channel as deep as 12 feet. As the shoaling seems to com from the east side it is probable that a dike on that side about 3,00 feet long, would maintain the required depth and width.

The channel through New Baltimore Bar, near Willow Island Light which was dredged in 1897, has filled up considerably. Until a dike i built from the light to the New York State dike, on the east side o the channel, this shoaling will continue. The free flow of the wate west of Barren Island in times of freshets, and thence diagonall across the west dike, is also a detriment to the stability of the channe

through this bar. The raising of the Barren Island Dike from Coeymans Landing to Barren Island to about 6 feet above mean low water, or the construction of a dike from the north end of the west dike to the west shore, to the same elevation above mean low water would, by throwing the water back into the channel above the present shoals, help to maintain the required depth and width.

At Mulls Cross-over the results of the rock removal and dredging have been very satisfactory, but in order to obtain the best results the channel should be dredged still farther to the west, between the south end of the rubblestone dike and North Coeymans ice houses, and a reef of rock lying about midway between these points should be removed, for the channel will scour itself and this reef may become dangerous.

The channels dredged through other shoals have all shoaled more or less, and it is evident that frequent dredging will be necessary in order to maintain a channel through them of the required width and depth.

The channel between Bath Shoal and the foot of Broadway, Troy, which is generally from 200 to 250 feet wide and 12 feet deep, has maintained its depth and width so far.

The following table, compiled from data furnished by the soundings taken since the opening of navigation in the spring of 1898, shows the depth and width of the channels through the bars as compared with those of 1897:

Locality.	1897.		1898.	
	Width.	Depth.	Width.	Depth.
	Feet.	*Feet.*	*Feet.*	*Feet.*
Coxsackie Shoal	300	12	100	12
Stone House Bar	200	12	50	11.5
New Baltimore Bar (Willow Island)	100	11	300	11
Coeymans Cross-over	250	11.5	250	11.5
Mulls Cross-over	150	11.5	100	12
Nine Mile Tree Cross-over	200	11.5	250	11.5
Castleton Bar	250	11.5	50	11.5
Cedar Hill Bar	100	11.5	170	11.5
Winnies Bar	150	12	70	11.5
Stone Light Shoal	100	11.5	180	11.5
Bogart Light Shoal	100	12	120	11.5
Douws Point Cross-over	50	12	150	12
Cuylers Bar	200	12	100	12
Through draws of bridges at Albany	100	12	100	11.5
Bath Cross-over	170	10.5	130	11.5
Bath Shoal	250	12	140	12
Kellogg Shoal	300	12	70	12
Fishhouse Shoal	260	12	250	12
Round Shoal	200	12	130	12
Covills Folly	200	12	180	12
Opposite Breaker Island	120	12	180	12
Van Buren Bar	120	12	190	12
Washington Bar	40	12	200	12
Opposite Watervliet Arsenal	60	9	100	11.5
Arsenal to Congress street, Troy	100	9	70	12
Congress street to Broadway, Troy	150	8.5	250	11
Broadway to State dam, Troy	50	5.5	50	5.5

All depths in this report, unless otherwise stated, refer to the plane of mean low water.

This improvement has been under the local charge of Mr. R. H. Talcott, assistant engineer, who has been stationed at Albany.

The revised project for the improvement of this river, adopted by Congress in the river and harbor act of July 13, 1892, gave the estimated cost of the work as $2,447,906.56, provided it was completed

within five years. All of this amount has been appropriated. Out of this appropriation there is due contractors the sum of about $76,000, which leaves less than $85,000 with which to complete the improvement.

Estimates based on recent surveys show that it will still require $2,246,769.80 to complete the work. This increase is due to the fact that the actual amount of dredging has been greater than was contemplated in the original project. The quantity of rock to be removed is much larger and the contract prices were higher than was estimated. The quantity of dredging has been increased, partly from the fact that the regulation of the river has caused the moving of large quantities of sand and silt downstream, the removal of which was not contemplated in the original estimate. Necessary changes in the location of the channel lines have also added somewhat to the amount. No work has as yet been undertaken between Broadway and the State dam at Troy, where the heaviest portion of the rock excavation remains to be done.

The following is a detailed estimate of the cost of completing this work in accordance with the present project, which has been adopted by Congress:

Cost of dredging between Coxsackie and Albany	$202,540.72
Cost of dredging between Albany and State dam	885,250.00
Cost of rock excavation, including sand covering, between Coxsackie and Albany	25,000.00
Cost of rock excavation, including rock covering, between Albany and State dam	750,000.00
Cost of dike work	257,000.00
Contingencies and engineering expenses, 10 per cent	211,979.08
Total	2,331,769.80
Less amount available	85,000.00
Estimated amount required to complete project	2,246,769.80

In addition to this amount it is estimated that it will require an annual expenditure of at least $100,000 for maintenance of the work after its completion.

This estimate is submitted by authority of the Chief of Engineers, dated February 23, 1898.

Money statement.

July 1, 1897, balance unexpended	$507,556.57
Amount appropriated by sundry civil act approved July 1, 1898	160,406.56
	667,963.13
June 30, 1898, amount expended during fiscal year	466,125.44
July 1, 1898, balance unexpended	201,837.69
July 1, 1898, outstanding liabilities	116,117.48
July 1, 1898, balance available	85,720.21
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	500,000.00

Appropriations.

By act of—	
June 30, 1834	$70,000.00
July 2, 1836	100,000.00
March 3, 1837	100,000.00
July 7, 1838	100,000.00
August 30, 1852	50,000.00
June 26, 1864, allotment	33,000.00
June 23, 1866	50,000.00
March 3, 1867	305,188.00
July 25, 1868, allotment	85,000.00
April 10, 1869, allotment	89,100.00
July 11, 1870	40,000.00
March 3, 1871	40,000.00
June 10, 1872	40,000.00
March 3, 1873	40,000.00
June 23, 1874	40,000.00
March 3, 1875	40,000.00
August 14, 1876	50,000.00
June 18, 1878	70,000.00
March 3, 1879	30,000.00
June 14, 1880	$20,000.00
March 3, 1881	15,000.00
August 2, 1882	10,000.00
July 5, 1884	30,000.00
August 5, 1886	26,250.00
August 11, 1888	75,000.00
September 19, 1890	150,000.00
July 13, 1892	187,500.00
March 3, 1893	500,000.00
August 18, 1894	145,000.00
March 3, 1895	500,000.00
June 11, 1896	480,000.00
June 4, 1897	475,000.00
Total	3,986,038.00
Received from other sources	792.57
Total	3,986,830.57

ABSTRACT OF PROPOSALS.

Abstract of proposals for furnishing rubble and paving stone on dikes in Hudson River, New York, received in response to advertisement dated August 9, 1897, and opened September 9, 1897, by Lieut. Col. William Ludlow, Corps of Engineers.

No.	Name of bidder.	Rubblestone, 3,800 cubic yards.		Paving stone, 1,500 cubic yards.		Total.
		Per cubic yard.	Amount.	Per cubic yard.	Amount.	
1	William D. Fuller	$0.94	$3,102	$1.95	$2,925	$6,027
2	The International Contracting Company	1.25	4,125	1.50	2,250	6,375
3	Frank Pidgeon	1.20	3,960	4.00	6,000	9,960

COMMERCIAL STATISTICS.

Classification.	Reported for 1897.		State canals in 1896.	
	Tons.	Value.	Tons.	Value.
General merchandise	340,080	$43,811,070	469,666	$37,832,571
Grain, flour, feed, etc	13,655	159,550	931,151	18,505,034
Lumber and timber	59,740	2,705,340	302,000	4,893,516
Fuel	146,005	515,901	333,367	1,577,533
Building material	189,446	841,149	198,649	2,803,786
Ice	585,090	773,090	114,015	114,015
Total	1,334,016	48,806,100	2,348,848	65,726,455

Number of passengers carried in 1897, 612,000.

In the above table the canal statistics for 1896 are given, as it will be at least a month before the report of the superintendent of public works for the State of New York, which will contain the information for 1897, will be obtainable.

Statement of the number and tonnage of all vessels belonging to the port of Albany July 1, 1897.

Character of vessels.	Number.	Registered tonnage.
Steam vessels	156	25,414.40
Sailing vessels	31	2,206.14
Barges	51	10,976.67
Canal boats	136	13,797.95

This is the latest information obtainable in regard to the number and tonnage of vessels. The surveyor of customs at Albany states that the information for the fiscal year 1898 will not be ready until about August 1, 1898.

G 5.

IMPROVEMENT OF HARBOR AT SAUGERTIES, NEW YORK.

[This work was in the charge of Brig. Gen. William Ludlow (now Maj. Gen.), United States Volunteers, lieutenant-colonel, Corps of Engineers, until October 1, 1897.]

The improvement of this harbor began in 1887 and by June 30, 1892, it had been completed, at a cost of $42,000. Two dikes were constructed, the length of the north one being 2,058 feet and of the south one 2,363.5 feet. The depth in the channel was increased to 8 feet at mean low tide. Since 1892 the expenditures have been applied to maintenance. A history of the improvement can be found in the Report of the Chief of Engineers for 1895, page 910.

No work was done during the year, owing to lack of funds.

The steamboat interests using the harbor report that the depth in the channel remains unchanged. The dikes are in good condition except the timber and piling above water, which are decayed and will soon require extensive repairs. The cost of maintenance is estimated at $5,000 biennially.

Money statement.

July 1, 1897, balance unexpended	$341.90
June 30, 1898, amount expended during fiscal year	9.11
July 1, 1898, balance unexpended	332.59
Amount required for maintenance in fiscal year ending June 30, 1900 .. Submitted in compliance with requirement of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	2,500.00

Appropriations.

By act of—		By act of—	
July 5, 1884	$5,000	August 18, 1894	$5,000
August 5, 1886	15,000	June 3, 1896	2,500
August 11, 1888	12,000	Total	54,000
September 19, 1890	10,000		
July 13, 1892	5,000		

COMMERCIAL STATISTICS.

Vessels employed in trade.

Class.	Number.	Tonnage.	Draft.
			Feet.
Steam	5	2,000	7
Sail	12	2,400	9
Tow	7	1,800	7 to 11

Freight handled.

Articles.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*
Bluestone	70,000	100,000	40,000
Coal and lumber	30,000	.....	.....
Coal	.....	10,000	5,000
Paper manufactures	20,000	.....	.....
Building material	.....	2,500	1,000
General merchandise	25,000	7,800	5,000
Total	145,000	120,000	51,000

G 6.

IMPROVEMENT OF HARBOR AT RONDOUT, NEW YORK.

[This district was in the charge of Brig. Gen. William Ludlow (now Maj. Gen.), United States Volunteers, lieutenant-colonel, Corps of Engineers, until October 1, 1897.]

The improvement of this harbor consists in widening and deepening Rondout Creek by means of dikes and dredging. Work began in 1872 and was completed in 1880, at a cost of $90,000, a channel depth of 14 feet having been secured. Since 1880 the expenditures have been applied to maintenance. A history of the work is printed in the Report of the Chief of Engineers for 1895, page 913.

No work was done during the present fiscal year. A slight shoaling has occurred in the channel. The dikes need some repairs where breaks have occurred and where the stone filling has settled.

Occasional expenditures will be required for maintenance. It is estimated that a biennial appropriation of $5,000 will be sufficient for that purpose.

Money statement.

July 1, 1897, balance unexpended	$4,791.86
June 30, 1898, amount expended during fiscal year	107.62
July 1, 1898, balance unexpended	4,684.24
Amount (estimated) required for completion of existing project	7,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	7,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

Appropriations.

By act of—		By act of—	
June 12, 1872	$10,000	August 11, 1888	$5,000
March 3, 1873	20,000	September 19, 1890	5,000
June 8, 1875, allotment	1,000	July 13, 1892	5,000
August 14, 1876	30,000	August 18, 1894	5,000
June 15, 1878	30,000	June 3, 1896	2,500
August 2, 1882	2,000		
July 5, 1884	1,000	Total	119,000
August 5, 1886	2,500		

COMMERCIAL STATISTICS.

Freight handled.

Articles.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*
General merchandise	667,000	900,000	900,000
Coal	400,000	380,250	385,000
Brick	286,000	290,000	280,000
Building stone	200,000	210,300	215,000
Cement, lime, and sand	517,500	512,500	510,000
Ice	.....	40,000	40,000
Total	2,070,500	2,333,050	2,330,000

Regular lines of steamers carry over 150,000 passengers annually.
The character and number of vessels employed in trade could not be procured.

G 7.

IMPROVEMENT OF HARBOR AT PEEKSKILL, NEW YORK.

[This work was in the charge of Brig. Gen. William Ludlow (now Maj. Gen.), United States Volunteers, lieutenant-colonel, Corps of Engineers, until October 1, 1897.]

This improvement has for its object the excavation and maintenance of a 10-foot channel along the entire wharf front of Peekskill; also in extending it north and south until it joins the deep-water channel of the Hudson River.

A description of the locality and a history of the work done can be found in the Report of the Chief of Engineers for 1897, page 1016.

No work was done during the present fiscal year, there being no funds available for that purpose. A shoaling has occurred in the channel dredged during the previous year.

Money statement.

July 1, 1897, balance unexpended	$203.70
June 30, 1898, amount expended during fiscal year	4.27
July 1, 1898, balance unexpended	199.43
Amount (estimated) required for completion of existing project	40,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

Appropriation.

By act of June 3, 1896 ..... $10,000

COMMERCIAL STATISTICS.

Freight handled.

Articles.	1894.	1896.	1897.
	Tons.	*Tons.*	*Tons.*
General merchandise	105,880	150,200	151,300
Building material	42,000	36,500	40,500
Iron ore and manufactured articles	74,300	69,300	60,000
Coal and wood	35,275	16,500	58,000
Lumber	40,500	48,500	44,500
Molding sand	225,000	225,000	50,000
Total	522,955	546,000	404,300

Ten steamboats, 2 freight boats, and 910 sailing vessels and other craft were engaged in carrying above freight.

G 8.

IMPROVEMENT OF PASSAIC RIVER, NEW JERSEY.

[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until October 1, 1897.]

A description of this locality and the history of the work which has been done are printed in the Report of the Chief of Engineers for 1897, pages 1128 and 1129.

No work was done during the present fiscal year, owing to the lack of funds.

A channel of the desired width has been obtained as far as Newark. Above there the desired depth and width have been secured, except at Rutherford Park Bar.

After completion of this work an annual or biennial appropriation will be required for maintenance, in order to preserve this improvement.

Money statement.

July 1, 1897, balance unexpended	$361.47
June 30, 1898, amount expended during fiscal year	323.66
July 1, 1898, balance unexpended	37.81
Amount (estimated) required for completion of existing project	94,347.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

Appropriations.

By act of—		By act of—	
June 10, 1872	$25,000	July 5, 1884	$28,000
March 3, 1873	25,000	August 5, 1886	26,250
June 23, 1874	20,000	August 11, 1888	35,000
March 3, 1875	20,000	September 19, 1890	45,100
August 10, 1876	10,000	July 13, 1892	45,000
June 18, 1878	10,000	August 18, 1894	15,000
March 3, 1879	2,000	June 3, 1896	15,000
June 14, 1880	32,000		
March 3, 1881	50,000	Total	453,350
August 2, 1882	50,000		

COMMERCIAL STATISTICS.

Freight handled and shipped by water.

Articles.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*
Building materials	277,911	297,725	409,017
Ores and metals	147,470	124,725	96,167
Fertilizers	70,752	94,191	72 612
Coal	121,838	96,490	113,406
Miscellaneous merchandise	362,855	316,247	318,152
To and from Hackensack River	278,140	314,235	361,370
Total	1,258,966	1,243,613	1,370,724

A statement of the number, character, tonnage, etc., of the vessels engaged in this trade could not be obtained.

G 9.

IMPROVEMENT OF CHANNEL BETWEEN STATEN ISLAND AND NEW JERSEY.

[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until October 1, 1897.]

A description of this waterway and a history of the work done are printed in the Annual Report of the Chief of Engineers for 1897, pages 1130 to 1132.

No funds being available for continuing this improvement, no work was done during the fiscal year.

At the close of the last fiscal year the channel had a depth of 14 feet, mean low water, and a least width of 250 feet. It practically retains its full depth at the present time. The width, however, has been reduced, owing to washing in of material from the adjacent flats.

This improvement, after its completion, will require an annual expenditure for maintenance.

Money statement.

July 1, 1897, balance unexpended	$29.69
June 30, 1898, amount expended during fiscal year	29.69
Amount (estimated) required for completion of existing project	32,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	32,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

Appropriations.

By act of—		By act of—	
June 23, 1874	$50,000	August 11, 1888	$15,000
August 14, 1876	10,000	September 19, 1890	15,000
June 18, 1878	15,000	July 13, 1892	15,000
June 14, 1880	29,000	August 18, 1894	6,000
August 2, 1882	40,000	June 3, 1896	13,000
July 5, 1884	10,000		
August 5, 1886	15,000	Total	233,000

COMMERCIAL STATISTICS.

Articles.	Tons.	Value.
From Elizabeth and vicinity	3,518,682	$28,711,335
From Perth Amboy and vicinity	3,660,249	28,053,624
From South Amboy and Raritan River	3,321,901	31,622,018
Total	10,500,832	88,386,977

This commerce consists principally of coal, together with building material, oils, fertilizers, grain, and miscellaneous freights.

The tonnage for 1897 shows an increase of 635,768 tons over that reported for 1895 and an increase of 1,247,729 tons over that reported for 1896.

G 10.

IMPROVEMENT OF ELIZABETH RIVER, NEW JERSEY.

[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until October 1, 1897.]

A history of this work and a description of the locality are given in the report of the Chief of Engineers for 1897, pages 1134 and 1135.

Operations during the year have consisted in redredging to a depth of 7 feet the shoal section of the river between South and Summer streets, Elizabeth, under a contract entered into with James McSpirit, Jersey City, N. J., on May 12, 1897, at a cost of 34 cents per cubic yard, prism measurement. Work began November 10 and was completed December 30, 1897, 7,669 cubic yards of material having been removed. The work was done under the supervision of Mr. C. S. Kelsey, assistant engineer.

It has been found impossible to complete this improvement within the limits of the estimated cost, owing to the frequent necessity of redredging sections of the river where shoaling has occurred.

When work was suspended a channel 7 feet deep and from 30 to 60 feet wide had been secured from the mouth to Bridge street, Elizabeth. It has, however, probably deteriorated considerably since then. To maintain a channel of the desired dimensions an annual appropriation of $2,500, or a biennial appropriation of $5,000, is considered necessary.

Money statement.

July 1, 1897, balance unexpended	$3,189.09
June 30, 1898, amount expended during fiscal year	3,189.09

Appropriations.

By act of—		By act of—	
March 3, 1879	$7,500	July 13, 1892	$5,000
June 14, 1880	7,500	August 18, 1894	3,000
March 3, 1881	4,000	June 3, 1896	3,160
August 2, 1882	8,000		
September 19, 1890	5,000	Total	43,160

COMMERCIAL STATISTICS.

Freight received and shipped by water.

Articles.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*
Coal	13,300	18,000	14,270
Lumber	.....	6,700	3,000
Building material	8,000	8,650	8,750
Miscellaneous	350	2,716	2,845
Total	21,650	36,066	28,865

A statement of the number, character, tonnage, etc., of the vessels employed in this trade could not be procured.

G 11.

IMPROVEMENT OF RARITAN RIVER, NEW JERSEY.

[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until October 1, 1897.]

A description of this river and a history of the work done are printed in the Report of the Chief of Engineers for 1897, pages 1136 and 1137.

At the beginning of the present year the breaking up of rock was in progress, under a contract entered into with P. Sanford Ross on March 13, 1897. The shale rock was broken up into pieces which could be handled by a dredge, at a cost of 59 cents per ton. Eight thousand six hundred and ninety-four tons had been broken up last year, and about 3,625 tons during the present year, but of this amount 857 tons was removed below the 11-foot mark and was not paid for. Broken rock amounting to 5,070 tons, and gravel, 2,017 tons, was removed by Government dredging plant, and was utilized in building unfinished portions of Dike C, at the middle ground, which is now 2,320 feet long and built to a height of about 3 feet above mean high water.

The work done increased the channel width from 60 to 100 feet for a distance of 400 feet; for an additional distance of 200 feet a width of 100 feet was made, and for a farther distance of 100 feet a width of 50 feet was made. The upper end of the 100-foot channel is now within 500 feet of the Delaware and Raritan Canal.

The cost of the work, per ton of 2,000 pounds, was as follows:

Breaking up rock by contract	$0.59
Removing rock with Government plant	.503
Towing to site of dike	.12
Discharging and placing in dike	.14
Total	1.353

This work was done under the immediate supervision of Mr. C. S. Kelsey, assistant engineer.

Authority to sell the dredging plant belonging to this improvement, on suspension of operations, was granted by the Secretary of War on August 10, 1897. Proposals were invited, and opened September 16, 1897, and the plant was disposed of to the highest bidders, as follows: Dredge *Alpha*, three scows, tug *Mary* and equipment, to W. H. H. Achuff & Co., Philadelphia, Pa., for $17,200, and the tug *Ant* to Patrick Monks, Brooklyn, N. Y., for $3,050. The sale and transfer of this property was completed September 29, 1897.

Money statement.

July 1, 1897, balance unexpended	$11,916.51
June 30, 1898, amount expended during fiscal year	11,916.51
Amount (estimated) required for completion of existing project	1,442,412.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

Appropriations.

By act of—		By act of—	
June 18, 1878	$200,000	August 11, 1888	$50,000
March 3, 1879	60,000	September 19, 1890	50,000
June 14, 1880	100,000	July 13, 1892	40,000
March 3, 1881	25,000	August 18, 1894	20,000
August 2, 1882	25,000	June 3, 1896	20,000
July 5, 1884	35,000		
August 5, 1886	26,250	Total	651,250

In addition to the above, $13,963 was appropriated for improving New Brunswick Harbor, N. J., in 1836–37.

Abstract of proposals for purchase of 1 dredge, 3 scows, 2 tugs and equipment, received in response to advertisement dated August 17, 1897, and opened September 16, 1897, by Maj. H. M. Adams, Corps of Engineers.

No.	Name and address of bidder.	Lot I. Dredge Alpha and 3 scows.	Lot II. Tug Ant.	Lot III. Tug Mary.
1	Jas. McSpirit & Sons, Jersey City, N. J		$1,700	
2	J. H. Gregory, Perth Amboy, N. J	$1,911	312	$1,112
3	George J. Schoeffel, Brooklyn, N. Y		3,000	
4	John Dickson, New York City			1,051
5	Wm. T. Jenkins, New York City			1,500
6	A. F. Chapman & Co., Buffalo, N. Y	4,600		
7	Niebrugge & Day, New York City	$12,230 for Lots I and II.		
8	W. H. H. Achuff & Co., Philadelphia, Pa	15,000	2,700	2,200
9	Frank Pidgeon, Saugerties, N. Y	13,151		
10	John G. Forsythe, Perth Amboy, N. J	5,100		2,100
11	James Kennedy, New York City			2,010
12	George Hegarty, New York City			1,500
13	Chester T. Caler, Norfolk, Va	1,610	1,010	
14	Hugh P. Sheriden, New York City		2,000	
15	Patrick Monks, Brooklyn, N. Y		3,050	
16	E. S. Belden, Hartford, Conn	5,000		
17	E. G. & J. S. Packard, New York City		2,105	
18	James Burche, Philadelphia, Pa	2,000	200	400
19	Newburg Dredging Co., Newburg, N. Y	7,500		
20	Joseph Weeks, Long Island City, N. Y		811	511

COMMERCIAL STATISTICS.

Freight received and shipped by water.

Articles.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*
Coal, clay, ores, etc	400,055	400,301	311,046
Manufactures, mainly brick	355,788	489,683	652,922
Lumber			40,428
Miscellaneous	219,258	246,990	214,356
Total	975,101	1,136,974	1,218,752

The above freight was carried in vessels, making 13,349 trips. A statement of the number, character, tonnage, etc., of vessels could not be procured.

G 12.

IMPROVEMENT OF SOUTH RIVER, NEW JERSEY.

[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until October 1, 1897.]

A description of this stream and a history of the work done are printed in the Report of the Chief of Engineers for 1897, pages 1139 and 1140.

No work was done during the present year, the available funds being insufficient for that purpose.

The channel depth to Washington is 4½ feet at mean low water, and from Washington to the Raritan River Railroad Bridge it is about 5 feet.

Money statement.

July 1, 1897, balance unexpended	$582.8
June 30, 1898, amount expended during fiscal year	60.6
July 1, 1898, balance unexpended	522.1
Amount (estimated) required for completion of existing project	88,975.0
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	10,000.0

Appropriations.

By act of—		
March 3, 1871	$15,000	
March 3, 1873	5,000	
		$20,00
June 14, 1880	40,000	
March 3, 1881	6,000	
August 2, 1882	10,000	
August 5, 1886	5,000	
August 11, 1888	5,000	
September 19, 1890	5,000	
July 13, 1892	7,000	
August 18, 1894	5,000	
June 3, 1896	5,000	
		88,00
Total		108,00

COMMERCIAL STATISTICS.

Freight received and shipped by water.

Articles.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*
Coal, clay, ore, etc	31,092	70,738	64,91
Manufactures, brick, etc	140,070	145,570	243,18
Miscellaneous	6,632	475	46
Total	177,794	216,783	308,56

The above freight was carried in vessels making 3,507 trips. A statement of the number, character, tonnage, etc., of vessels could not be procured.

G 13.

IMPROVEMENT OF RARITAN BAY, NEW JERSEY.

[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until October 1, 1897.]

For a history of this work and a description of the locality, see Report of the Chief of Engineers for 1897, pages 1142 and 1143.

No work was done during the present fiscal year, the available funds not being sufficient for that purpose.

The work at Seguine Point is not of a permanent character. The South Amboy Channel has been dredged and redredged to a depth of 21 feet, with widths varying from 100 to 300 feet. As soon as operations have been suspended the action of the cross currents again fills the dredged channels on the sides, and to some extent in the center. It will require an annual expenditure for maintenance upon the completion of the work.

Money statement.

July 1, 1897, balance unexpended	$4,116.04
June 30, 1898, amount expended during fiscal year	962.40
July 1, 1898, balance unexpended	3,153.64
Amount (estimated) required for completion of existing project	130,375.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.

Appropriations.

By act of—		By act of—	
March 3, 1881	$50,000	July 13, 1892	$40,000
August 2, 1882	50,000	August 18, 1894	40,000
July 5, 1884	20,000	June 3, 1896	75,000
August 5, 1886	37,500		
August 11, 1888	25,000	Total	377,500
September 19, 1890	40,000		

COMMERCIAL STATISTICS.

Freight received and shipped by water.

Articles.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*
Coal, ores, etc.	3,098,479	3,619,165	3,605,514
Lumber	33,070	33,898	.....
Building material	.....	.....	45,368
Fertilizers	.....	.....	84,521
Manufactures	383,788	542,783	671,795
Merchandise	307,125	433,668	444,877
Total	3,822,462	4,629,514	4,852,075

A statement of the number, character, tonnage, etc., of the vessels carrying above freight could not be procured.

G 14.

IMPROVEMENT OF MATAWAN CREEK, NEW JERSEY.

[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until October 1, 1897.]

A detailed description of this locality and of the work done are printed in the Report of the Chief of Engineers for 1897, pages 1145 and 1146.

During the present year a channel was dredged from Winkson Creek to the upper dock at Matawan, under a contract entered into with James McSpirit, Jersey City, N. J., on May 12, 1897, at a cost of 18.75 cents per cubic yard.

This part of the channel was given a width of from 30 to 60 feet, and depth of 4 feet, at mean low water, the total amount of material removed having been 13,508 cubic yards.

After completion of the work slumps occurred in the mud bank at three localities, owing to the pressure of the spoil bank in the rear and the lessening of the support in the front. This caused a reduction of the channel width to 45 feet at Winkson Creek, 45 feet at Maggs' brickyard, and 30 feet at the bend below Matawan Steamboat Dock. The dredging was done under the supervision of Mr. C. S. Kelsey, assistant engineer.

Although more than the estimated cost of this work has been appropriated and expended, it has not been completed, owing to the necessity of redredging portions of the channel which had shoaled when operations were suspended. To maintain a channel of the desired dimensions it is estimated that it will require an annual sum of $3,000.

Money statement.

July 1, 1897, balance unexpended	$3,133.86
June 30, 1898, amount expended during fiscal year	3,133.86
Amount required for maintenance in fiscal year ending June 30, 1900. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	3,000.00

Appropriations.

By act of—		By act of—	
March 3, 1881	$15,000	August 18, 1894	$3,000
August 2, 1882	6,000	June 3, 1896	3,000
September 19, 1890	2,500		
July 13, 1892	9,620	Total	39,120

COMMERCIAL STATISTICS

Freight received and shipped by water.

Articles.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*
Grain		30,000	30,000
Lumber	225	5,000	5,000
Brick and building material	200,000	25,000	5,000
Farm produce, merchandise, etc	137,800	375,000	375,000
Total	338,025	435,000	415,000

A statement of the number, character, tonnage, etc., of the vessels employed in this trade could not be procured.

G 15.

IMPROVEMENT OF HARBOR AT KEYPORT, NEW JERSEY.

[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until October 1, 1897.]

A description of this locality and a history of the work done are printed in the Report of the Chief of Engineers for 1897, pages 1147 to 1149.

No work was done during the present fiscal year, owing to lack of funds.

This work is not of a permanent character. More than the amount of the estimate has been appropriated and expended on this work, and still the channel has not reached the desired dimensions. This is due to shoaling, which occurs when work is suspended. It is estimated that a channel of the desired dimensions can be maintained with an average annual expenditure of $5,000.

Money statement.

July 1, 1897, balance unexpended	$216.39
June 30, 1898, amount expended during fiscal year	216.39
Amount required for maintenance in fiscal year ending June 30, 1900... Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	5,000.00

Appropriations.

By act of—	
August 2, 1882	$30,475
July 13, 1892	5,000
August 18, 1894	5,000
June 3, 1896	2,500
Total	42,975

COMMERCIAL STATISTICS.

Freight received and shipped by water.

Articles.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*
Farm produce	156,700	60,700	63,700
Fertilizers	39,000	8,000	8,000
Coal and lumber	7,225	8,500	8,500
Fish and shellfish	.....	10,000	10,000
Miscellaneous	.....	18,000	18,900
To and from Matawan Creek	231,700	435,000	415,000
Total	434,625	540,200	524,100

A statement of the number, character, tonnage, etc., of the vessels engaged in this trade could not be procured.

G 16.

IMPROVEMENT OF SHOAL HARBOR AND COMPTON CREEK, NEW JERSEY.

[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until October 1, 1897.]

A description of this locality and a history of the work done are printed in the Report of the Chief of Engineers for 1897, pages 1150 and 1151.

No work was done during the year, as there were no funds available for that purpose.

A channel 4 feet deep and 75 feet wide had been dredged from deep water in Compton Creek to the 2-foot contour in Raritan Bay at the close of the previous fiscal year. It is probable, however, that it has shoaled since then. In order to maintain this work after completion it will require an annual or biennial expenditure.

Money statement.

July 1, 1897, balance unexpended	$58.88
June 30, 1898, amount expended during fiscal year	58.88
Amount (estimated) required for completion of existing project	48,130.00
Amount that can be profitably expended in fiscal year ending June 30, 1900	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	

Appropriations.

By act of—	
September 19, 1890	$5,000
July 13, 1892	3,000
August 18, 1894	3,000
June 3, 1896	5,000
Total	16,000

COMMERCIAL STATISTICS.

Freight received and shipped by water.

Articles.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*
Farm produce	50,000	60,000	70,000
Fish and shellfish	70,000	70,000	75,000
Coal	4,000	4,000	4,000
Fertilizers	20,000	25,000	25,000
Miscellaneous	8,000	8,000	10,000
Total	152,000	167,000	184,000

The above freight was carried in boats of from 2 to 4 feet draft. A statement of the number, character, and tonnage could not be procured.

An increase is reported in the number of vessels using Compton Creek.

G 17.

IMPROVEMENT OF SHREWSBURY RIVER, NEW JERSEY.

[This work was in the charge of Maj. H. M. Adams, Corps of Engineers, until October 1, 1897.]

A description of this locality and a history of the work done are printed in the Report of the Chief of Engineers for 1897, pages 1152 to 1155.

The work during the present year has consisted in completing a contract entered into April 1, 1897, with Frank H. Brainard, which was done on July 7, 1897. Dredging was carried on in the South Branch of the river, 1,040 cubic yards of material having been removed, at a cost of 35 cents per cubic yard. The width of the channel was increased from 50 to 110 feet around the turn opposite the stone dike above Seabright. Fender piles were also driven along the stone dike above Seabright and the timber work of an old dike obstructing navigation at Upper Rocky Point, on the North Branch, was removed.

This work was done under the immediate supervision of Mr. C. S. Kelsey, assistant engineer.

This project has not been completed, although the estimated cost has been appropriated and expended, because frequent redredging has been required at several of the shoals, and the dredging of an entirely new channel became necessary in order to prevent a stoppage of navigation. The securing of channels of the full projected width, 300 feet in the main stem and 150 feet in the branches, is by no means as important as maintaining channels of the full depth and from 100 to 150 feet wide. It is estimated that this can be done at an average annual cost of $10,000.

Money statement.

July 1, 1897, balance unexpended	$7,746.99
June 30, 1898, amount expended during fiscal year	7,746.99
Amount required for maintenance in fiscal year ending June 30, 1900. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	10,000.00

Appropriations.

By act of—		
August 30, 1852	$1,500	
March 3, 1871	14,000	
March 3, 1873	5,000	
		$20,500
June 18, 1878	18,000	
March 3, 1879	10,000	
June 14, 1880	30,000	
March 3, 1881	86,000	
August 2, 1882	30,000	
August 5, 1886	10,000	
August 11, 1888	10,000	
September 19, 1890	10,000	
July 13, 1892	10,000	
August 18, 1894	5,000	
June 3, 1896	15,000	
		234,000
Total		254,500

COMMERCIAL STATISTICS.

Freight received and shipped by water.

Articles.	1895.	1896.	1897.
	Tons.	*Tons.*	*Tons.*
Farm produce	258,000	290,000	300,000
Fish and shellfish	25,500	11,520	12,000
Coal	60,700	19,620	25,250
Lumber	131,700	300	1,250
Building material	1,900	7,090	8,000
Miscellaneous	152,300	539,600	550,000
Total	630,100	868,130	896,600

Passengers carried, 400,000.

The above freight was carried in boats of from 3 to 5 feet draft. A statement of the number, character, and tonnage could not be procured.

G 18.

IMPROVEMENT OF MANASQUAN (SQUAN) RIVER, NEW JERSEY.

The original project for the improvement of this stream was based on a survey made in 1879 and contemplated the construction of jetties at its mouth, to control and concentrate the scouring action of ebb tides; also in dredging the lower river and in removing wrecks and snags.

Congress inaugurated the improvement by an appropriation of $12,000 in 1879. The project was referred to a Board of Engineer Officers, who reported against the advisability of undertaking any improvement. In 1880 Congress made a second appropriation of $20,000 for this work, which made a total of $32,000 available.

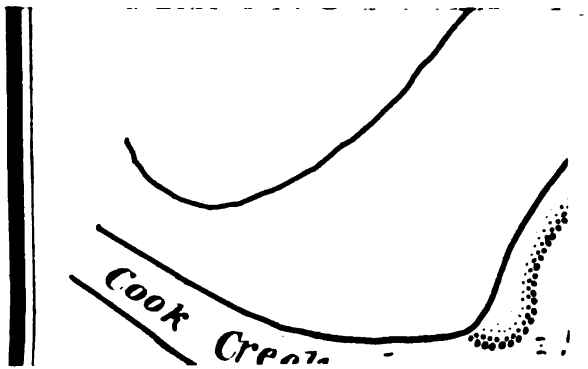
The engineer officer then in charge recorded his protest against undertaking a work of such magnitude and uncertainty with the funds available, but advised, if improvement was to be attempted, that the plan of the original project be followed. In accordance with this plan the appropriations of 1879 and 1880 ($32,000) were expended in constructing 1,515 linear feet of the north dike. A third appropriation of $7,000 having been made in 1882, it was expended in constructing 475 linear feet of the south dike.

Congress failed to continue making appropriations for carrying on the work after 1882, and seemed to have abandoned the improvement. In 1890 $2,000 was appropriated, to be expended at the discretion of the Secretary of War in removing obstacles placed by the Government at the mouth of the river. This expenditure was reported against on the ground that the depth on the bar did not exceed the depth where the channel crossed the ruins of the south dike; that the channel was liable at any time to shift to a position clear of the dike, and that only slight use was made of the inlet. The Secretary of War did not authorize the expenditure.

In October, 1897, the Manasquan River Improvement Association requested the Secretary of War to have a survey made in order to determine what should be done to prevent further injury to the Manasquan River and Inlet.

The survey having been authorized by the Chief of Engineers in letter dated November 8, 1897, it was made during the month of December, 1897, under the direction of Mr. C. S. Kelsey, assistant engineer.

It was found that the south shore had receded 500 feet since suspen-


Cook Creek

sion of work in 1883; that the south spit had worn away in the rear a distance of 350 feet normal to its axis; that the north shore had enlarged at a corresponding rate, and that the demolished south dike obstructed the entire channel. The channel also ran parallel to the shore for a distance of 800 feet before reaching an outlet, which caused a loss of directness in the discharge, thereby impairing its efficiency.

The reasons advanced in 1890 for withholding relief from this locality no longer have force. The obstructing dike can not now be passed as readily as the channel on the bar, which has a least depth of 2.3 feet at mean low water, nor has the expectation been realized that the channel would shift to a position clear of the obstruction, even after a period of seven years.

Unless improvement of this locality is resumed it will eventually result in the destruction of the north dike, which was built at a cost of $30,000.

A map is forwarded herewith which shows the changes that have occurred at this locality since the suspension of work in 1883.

In order to remedy the condition of affairs at the mouth of this river it is proposed to restore and complete the south dike and to extend it along the line indicated on the map until it reaches the shore; also to close two small passages between the islands and the main shore. The dikes are to be built of stone, the tops being 2 feet above mean high water and 3 feet wide, the sides to have slopes of 1 on 1.

The following is an estimate of the cost of completing this improvement:

Constructing shore arm to south dike, 1,200 linear feet, at $12 per foot	$14,400
Closing small passages, 150 linear feet, at $1.50 per foot	225
Repairing south dike, 300 linear feet, at $8 per foot	2,400
Repairing north dike	1,000
Engineering and contingencies	1,975
Total	20,000

The present condition of the inlet at the mouth of the river is undoubtedly worse than before any attempt was made to improve it, and it would seem only just that relief be given. It is respectfully recommended that this work be undertaken, and that in order to prosecute it economically, the estimated cost, less $1,700 on hand, or $18,300, be appropriated in one amount. This estimate is submitted by authority of the Secretary of War, dated March 15, 1898.

Money statement.

July 1, 1897, balance unexpended	$2,000.00
June 30, 1898, amount expended during fiscal year	300.00
July 1, 1898, balance unexpended	1,700.00
Amount that can be profitably expended in fiscal year ending June 30, 1900 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of June 4, 1897.	18,300.00

Appropriations.

By act of—	
March 3, 1879	$12,000
June 14, 1880	20,000
August 2, 1882	7,000
September 19, 1890	2,000
Total	41,000

COMMERCIAL STATISTICS.

The commerce on this river amounted to practically nothing during 1897, owing to the condition of the inlet at the mouth.

G 19.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

1. Wreck of canal boat in the Arthur Kill, New York and New Jersey.—An unknown canal boat went adrift in the Arthur Kill and sank in the channel near Woodbridge Creek. The obstruction was reported September 27, 1897, and its removal was authorized by Department letter of October 5, 1897.

Proposals for removing the wreck were invited by public notice of October 20, opened October 30, 1897, the award for removal being made to the lowest bidder, John H. Gregory, of Perth Amboy, N. J., at a cost of $173.

The wreck was removed and satisfactorily disposed of during November, 1897. Nothing of value was recovered from it.

2. Wreck of canal boat Harwick in Newark Bay, New Jersey.—This condemned canal boat floated off from the shore in the Kill van Kull, lodged near the channel opposite Bergen Point, New Jersey, and was abandoned by the owner. Notification of the wreck was received December 21, 1897. Its removal was authorized by Department letter of February 14, 1898.

Proposals for its removal were invited by public notice of January 31; opened February 10, 1898, the award being made to the lowest bidder, James McSpirit & Sons, of Jersey City, N. J., at a cost of $159.

The wreck was broken up and removed during February, 1898. Nothing of value was recovered from it.

G 20.

ESTABLISHMENT OF HARBOR LINES ON THE EAST SHORE OF HUDSON RIVER IN FRONT OF THE CITY OF YONKERS, NEW YORK.

ENGINEER OFFICE, UNITED STATES ARMY,
New York, N. Y., July 23, 1897.

GENERAL: I beg to forward herewith copy of letter from the mayor of Yonkers, N. Y., asking, in behalf of the property owners and the local authorities, that a harbor line be established extending directly from Mount St. Vincent, New York City, to a point 50 feet west of the northwest corner of the Glenwood wharf, in the city of Yonkers.

2. The accompanying blue print shows the existing conditions, the crooked bulkhead line, and the wharf line as now established by the city of Yonkers, and in a full, red, straight line the proposed pier and bulkhead line in one, as desired by the local interests and recommended by me.

Your obedient servant,
WILLIAM LUDLOW,
Lieut. Col., Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS, U. S. ARMY,
July 29, 1897.

Respectfully referred to the New York Harbor Line Board for consideration and report.

The Board will please indicate on a tracing the line recommended for adoption.

A. MACKENZIE,
Acting Chief of Engineers.

[Second indorsement.]

NEW YORK HARBOR LINE BOARD,
New York City, September 15, 1897.

Respectfully returned to the Chief of Engineers, inviting attention to report of the New York Harbor Line Board on this matter, dated September 11, 1897.

HENRY M. ROBERT,
Colonel, Corps of Engineers, President of the Board.

[Third indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
September 17, 1897.

Respectfully submitted to the Secretary of War.

The mayor of the city of Yonkers, N. Y., having requested that harbor lines be established at said place, the application was referred to the New York Harbor Line Board, to whose report (herewith), dated the 11th instant, attention is respectfully invited.

The Board recommends the establishment of a combined pierhead and bulkhead line, shown in red on the accompanying tracing and described in its report as follows:

Beginning at a point 50 feet west of the northwest corner of the existing wharf at Glenwood Point, in the city of Yonkers, N. Y., a straight line shall be drawn tangent to the high-water mark on the natural bank at Mount St. Vincent, near the northern line of the city of New York, which line shall be the pier and bulkhead line in front of the city of Yonkers.

I concur in the views of the Board, and recommend that the lines selected be approved and that the Secretary place his approval both upon the tracing, which has been prepared for his signature, and upon this paper.

JOHN M. WILSON,
Brig. Gen., Chief of Engineers,
U. S. Army.

[Fourth indorsement.]

WAR DEPARTMENT, *September 20, 1897.*

Approved.

R. A. ALGER,
Secretary of War.

REPORT OF THE NEW YORK HARBOR LINE BOARD.

HARBOR LINE BOARD,
New York City, September 11, 1897.

GENERAL: In compliance with your indorsement of July 29, 1897, the New York Harbor Line Board has considered the application of the mayor of the city of Yonkers, N. Y., dated July 19, 1897, for the establishment of harbor lines in front of that city, and has the honor to report as follows:

As authorized by your indorsement of August 3, 1897, a public hearing in this matter was held in the Army Building, New York City, on the 3d instant, due notice of which had been given in the public press.

There were present at the hearing the acting mayor of the city of

Yonkers, Mr. A. J. Prime, and Mr. L. M. Saunders, a large property holder. Mr. Prime made an argument presenting the views held by the mayor, the local authorities and the principal property owners, and in answer to questions by the Board stated why the city desired the Government to establish harbor lines in front of Yonkers.

After carefully considering the subject the Board is of the opinion that the combined pier and bulkhead line recommended by the mayor of Yonkers in his letter of July 19, 1897, addressed to Lieutenant-Colonel Ludlow, and recommended by that officer in his letter to the Chief of Engineers, dated July 23, 1897, may be established without injury to navigation, and is therefore recommended for adoption by the Secretary of War. This line is more particularly described as follows:

Beginning at a point 50 feet west of the northwest corner of the existing wharf at Glenwood Point, in the city of Yonkers, N. Y., a straight line shall be drawn tangent to the high-water mark on the natural bank at Mount St. Vincent, near the northern line of the city of New York, which line shall be the pier and bulkhead line in front of the city of Yonkers.

A tracing is forwarded upon which is delineated the line recommended by the Board for adoption.

Respectfully submitted.

HENRY M. ROBERT,
Colonel, Corps of Engineers.
G. L. GILLESPIE,
Colonel, Corps of Engineers.
WILLIAM LUDLOW,
Lieut. Col., Corps of Engineers.
C. W. RAYMOND,
Major, Corps of Engineers.
H. M. ADAMS,
Major, Corps of Engineers.

Brig. Gen. JOHN M. WILSON,
Chief of Engineers, U. S. A.

LETTER OF MR. JOHN G. PEENE, MAYOR OF YONKERS, N. Y.

MAYOR'S OFFICE, MANOR HALL,
Yonkers, N. Y., July 19, 1897.

DEAR SIR: For some time past there has been a growing necessity for the establishment of a harbor line along the Hudson River front at the city of Yonkers, which has resulted in the appointment of a committee of water-front owners to urge the establishment of such a line, and I have been requested by the common council of the city of Yonkers to cooperate with this committee. The question of the location of such a harbor line has been discussed and the general sentiment of the property owners and city authorities is that it should be a straight line, and it is now requested that such harbor line shall be a straight line extending from Mount St. Vincent Point, near the northern line of the city of New York, to a point 50 feet west of the northwest corner of the present existing wharf at Glenwood Point, in the city of Yonkers, and I, on behalf of the city of Yonkers, respectfully ask that such line be adopted at as early a date as possible.

Very respectfully,

JNO. G. PEENE, *Mayor.*

Lieut. Col. WILLIAM LUDLOW.

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